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JETRO

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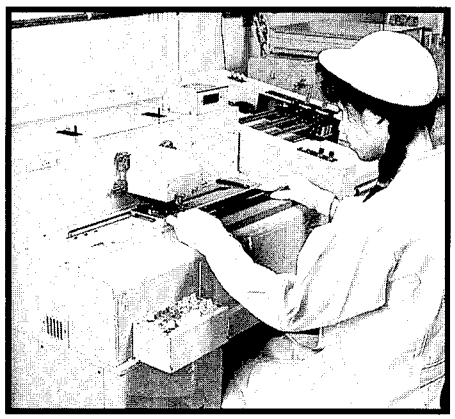
The aim of our magazine is to promote the international exchange of technology through the introduction of Japanese New Technology.



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Cover Photo: Advanced Reverse Manufacturing Technology for Effective Recycling of One-Time Use Cameras —Ashigara Factory of Fuji Photo Film Co., Ltd.— (Story on Pages 2-5)

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KEIRIN 本印刷物は，日本自転車振興会から，競輪収益の一部である機械工業振興資金の援助を受けて作成したものである。

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INNOVATIVE PRODUCTION NOW

This section describes a specialized section or whole process of a representative factory which excels in specific aspects of production.

Advanced Reverse Manufacturing Technology for Effective Recycling of One-Time Use Cameras

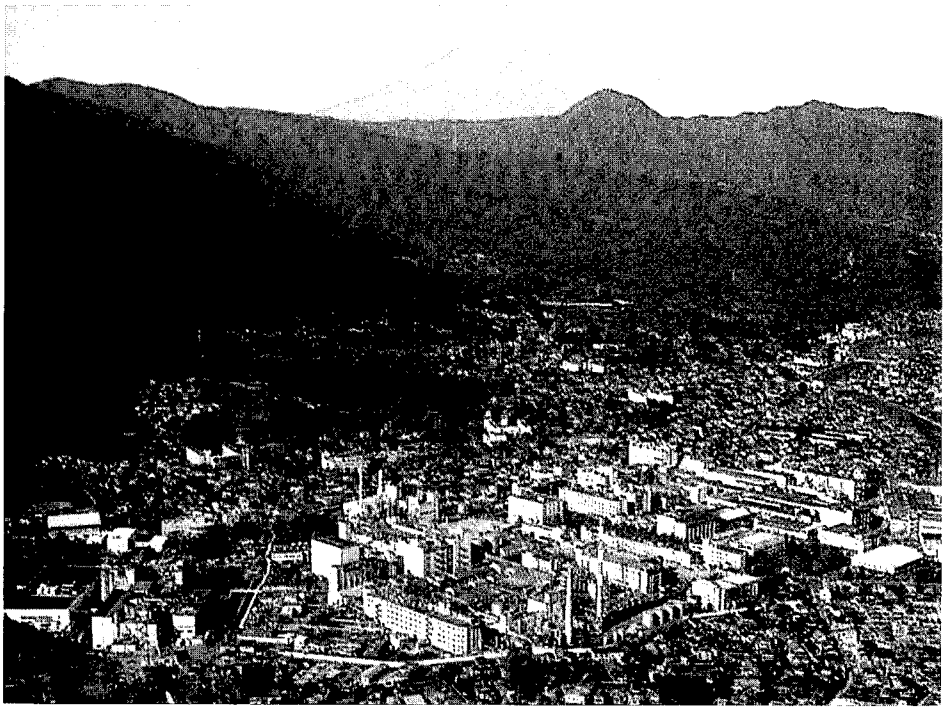
—Ashigara Factory of Fuji Photo Film Co., Ltd.—

Introduction

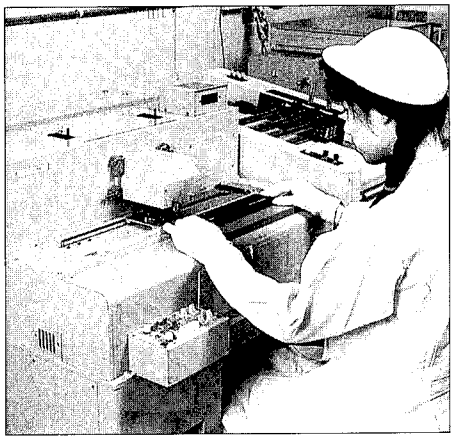
In the film manufacturing industry, the largeness of scale is a key effective factor enabling production at low cost. Therefore, today, photofilm factories are generally designed as large-scale facilities equipped with automated equipment for engaging in mass production. The industry is required to feature intensive capital investment, advanced technology and massive product sales capability. In view of these requirements, the worldwide photofilm industry is dominated by four global-scale companies, or one U.S., two Japanese and one German. Introduced in this issue is the effective 35-mm film production line and the advanced recycling line for the so-called QuickSnap one-time use cameras of the Ashigara Factory of Fuji Photo Film Co., Ltd., that has established a sound position as a global photofilm manufacturer.

The Ashigara Factory is situated in Ashigara Town, Kanagawa Prefecture, that is the place of founding and present location of its head office. The head office consists of the technologically advanced Ashigara Research Laboratories and the Production Engineering & Development Center as well as four domestic and ten overseas factories and related enterprises, with the Ashigara Factory assuming the primary role.

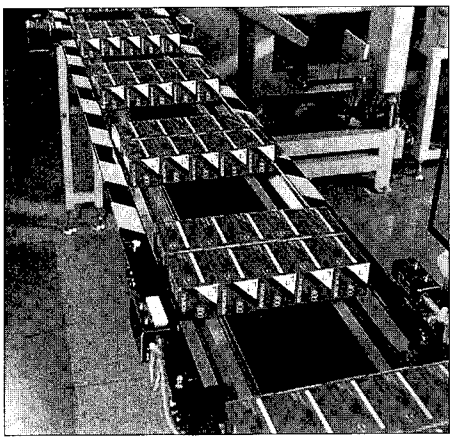
Photographic film is a product of which the quality is known only after the user takes pictures and develops and prints the film, and the color tones will differ or the pictures become defective even with the slightest inclusions of micrometer-level impurities. The manufacture of quality films involves the coating of more than 20 different layers of diverse types of materials, and the film becomes defective with the inclusion of impurity in any of these various layers, so the company has established highly automated impurity-elimination technologies and quality assurance systems for each process from the stage of raw material handling to the final stage of ultimate product finishing. In addition, since hyperclean air and water are prerequisites for ensuring product quality, the company has also established sophisticated technologies and management systems in connection with working environments. Due to the establishment of these advanced quality assurance and management technologies, the factory acquired the ISO9002 certification in 1995 and the ISO14001 certification in June 1997.



Bird's eye view of the Ashigara Factory



Inspection of 35-mm films



35-mm film packaging line

One-time use camera : QuickSnap

2. Description of Ashigara Factory

The Ashigara Factory is situated in Ashigara Town, Kanagawa Prefecture, at a spot close to Mt. Fuji and accessible from Tokyo by Shinkansen Line to Odawara Station, and thence about 25 min by taxi. The factory has a picturesque site of roughly 700,000 m^2 with deep foliage and an exquisite garden, and consists of a film raw material cellulose, triacetate and polyethylene terephthalate plant, a film plant, a used QuickSnap one-time use cameras disassembling, regeneration and recycling plant, the Ashigara Research Laboratories and the Production Engineering & Development Center. There is also a processed waste water adjustment pondage (with more than 20,000 carp) with water so pure it is supplied for treatment as drinking water for the Yokohama and Kawasaki regions.

The factory products include roughly 10,000 different products such as various types of films and photographic printing paper for cameras, video systems, instant cameras, microphotography and printing, for which an integrated manufacturing system is adopted for raw material treatment to the finishing of ultimate products. The aggregate labor force is 5,000 workers, consisting of 1,500 Ashigara Research Laboratories personnel, 500 Production Engineering and Development Center personnel and nearly 3,000 factory workers.

3. 35-mm Film Production Plant

In view of the nature of its products, the factory's film production processes are mostly accomplished inside dark rooms, while the processes themselves are fully automated. The film products which can be actually seen with the eyes are the film parts in the parts molding and ultimate product packaging processes, which are controlled with computers, so only a few workers are actually involved in these tasks. All the factory's film production facilities, instrumentation systems, system control technologies and ancillary equipment, have been developed by the company's Production Technology Department, and the factory's production capacity runs up to 60 million units annually.

4. Advanced Reverse Manufacturing Technology for QuickSnap

The company developed a new type of camera and marketed the product under the trade name of QuickSnap. Initially, a small-sized film called one-ten (110) was used, but later a 35-mm film came to be used which sold very well and became the company's main product that presently accounts for 15-16% of the company's amateur color film sales by volume.

With QuickSnap, the user purchases a unit, takes pictures and return the unit to one of the company's depots where the film is developed and printed and the photographs and the used film handed over to the user. From the viewpoint of environmental preservation and effective utiliza-

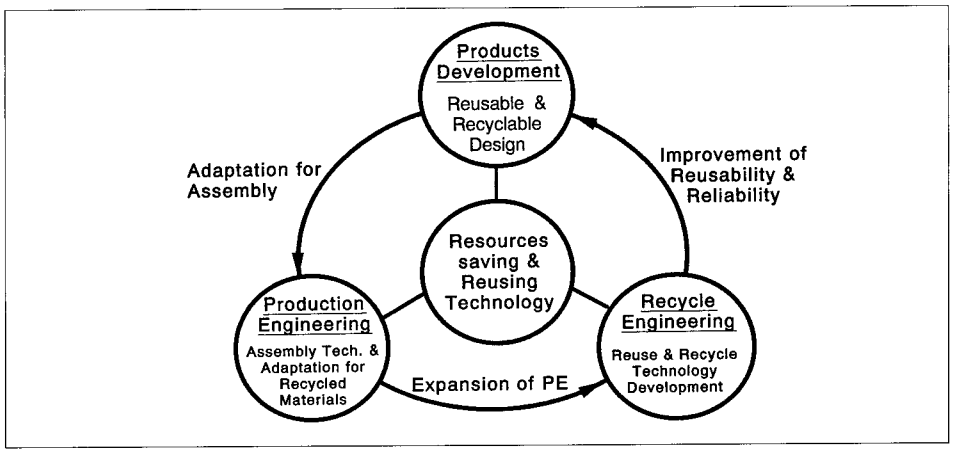


Fig.1 Circulation of Technology

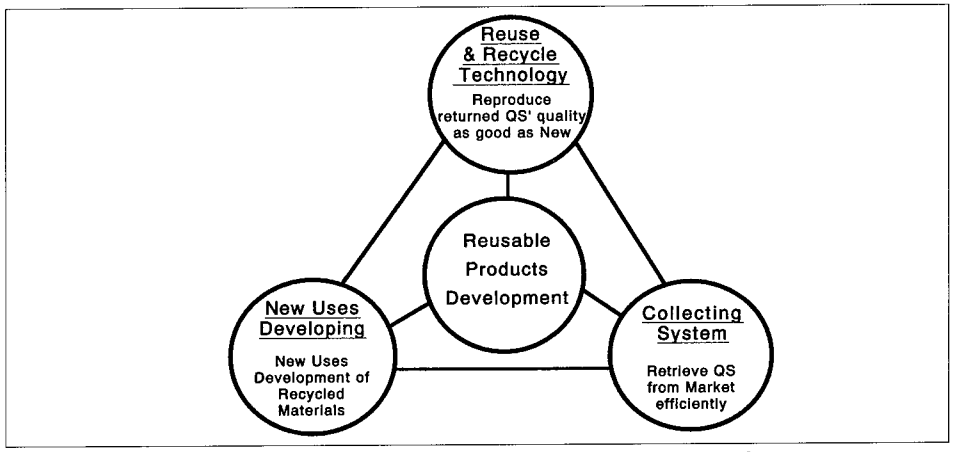
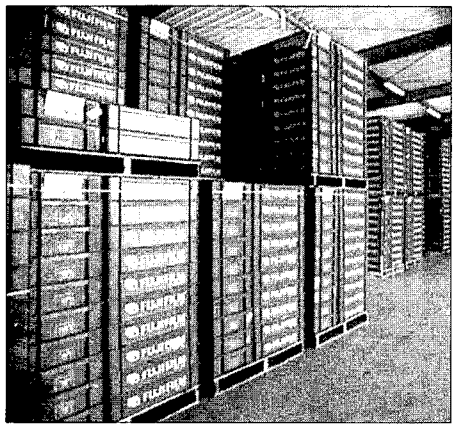
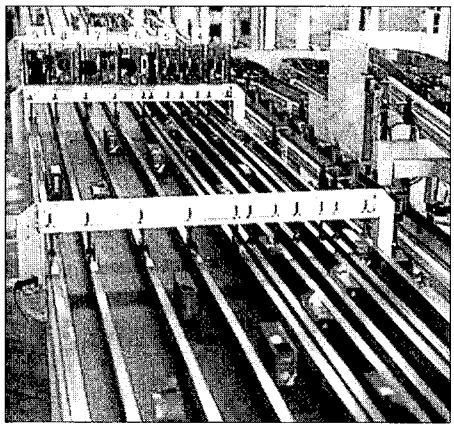


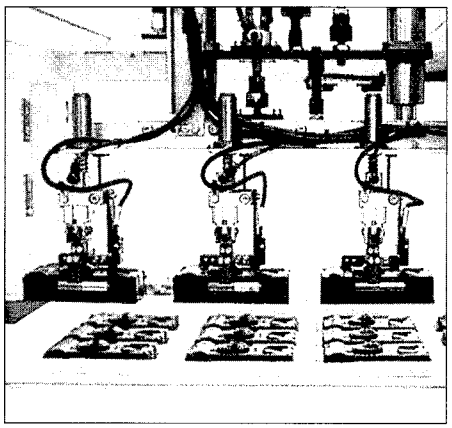
Fig.2 Structure of QuickSnap Reusing & Recycling System



Collected used QuickSnap cameras, ready for reuse and recycling processes



Sorting and arrangement line for various types of used QuickSnap cameras



Disassembling Line for front body

tion of materials, the company adopts the method of reuse and recycling the disassembled parts of the camera after the film is removed, while crushing and regenerating into raw materials the parts which are unusable intact. In 1990, the company constructed its QuickSnap Recycling Center and established an integrated system for product return to recycling, and the facility presently in operation at the Ashigara factory is the third-generation version of the initial system.

In the recycling business, the work of recovery is regarded as the most difficult task, but with the QuickSnap System, the company has established its unique developing and printing depot network, so there is the advantage of using these depots. The outstanding problem is how to most effectively and efficiently disassemble, reutilize and recycle the recovered products, and to cope with this technical issue, the company established at an early stage its unique reverse manufacturing technology in which the product designing and manufacturing methods are based on the concept of recycling the returned products. Therefore, the product assembling method is based on the method of assembling all parts from the inner to outer side parts to enable disassembly with ease. Unique mechanisms are introduced for the intermeshing of parts, with the result that more than 90% of the parts can be reused or recycled. Fig. 1 shows this basic concept, Fig. 2 the structure of QuickSnap reuse and recycling concept, Fig.3 the structural parts of QuickSnap and Fig. 4 the QuickSnap recycling flow.

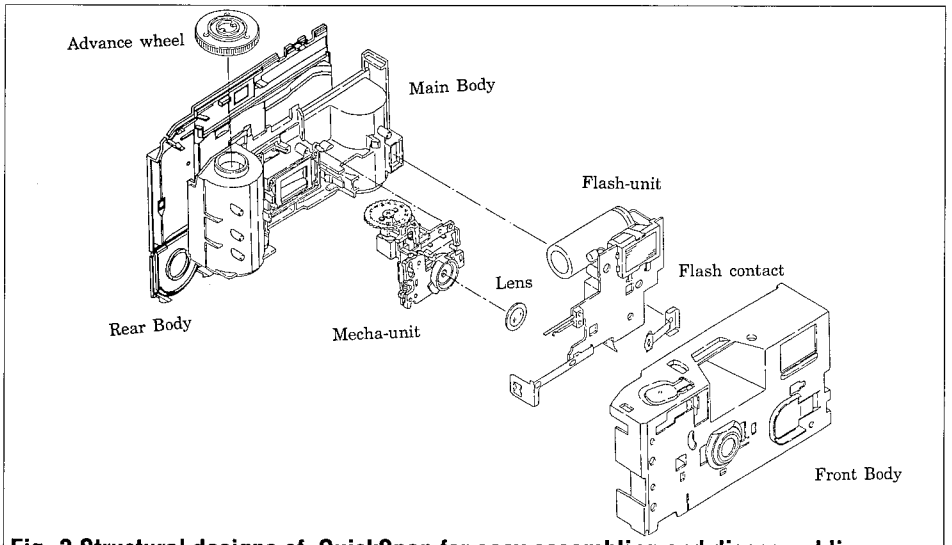
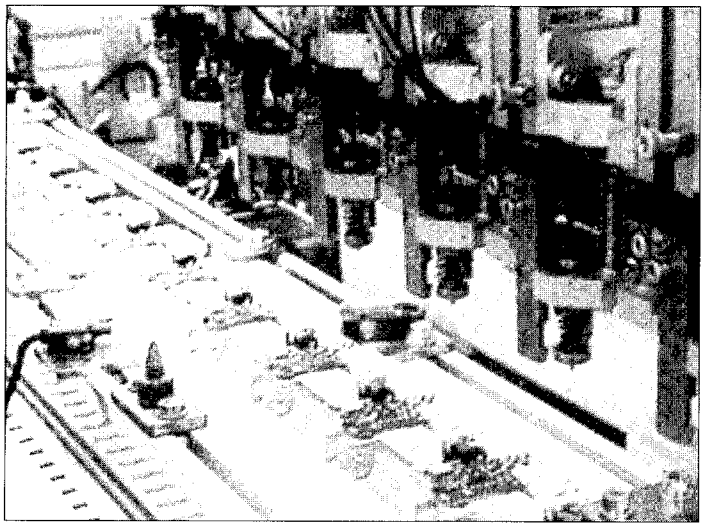
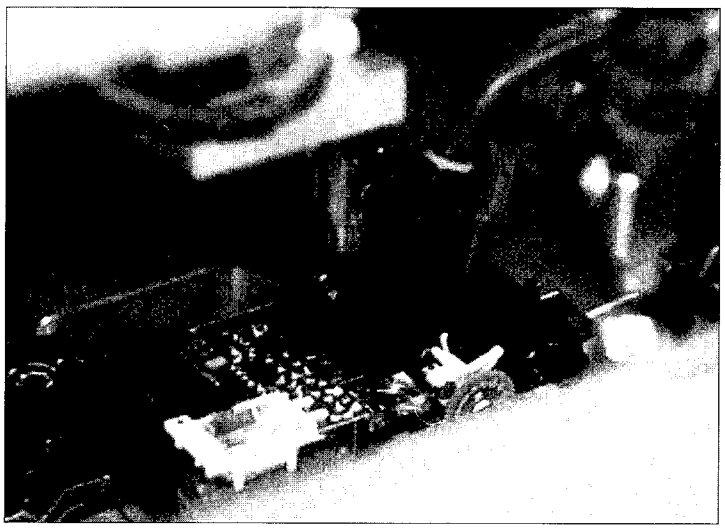


Fig. 3 Structural designs of QuickSnap for easy assembling and disassembling



Recovered various functional parts inspection line



Disassembling Line for mechanical units

At the present Recycling Center, the first floor accommodates a classification line to align the returned used cameras, and a process to remove the outside decorative paper from the returned camera. The camera is then sent to the disassembling line on the 2nd floor where parts such as the strobe unit, lens unit, lens, mechanical unit and battery are disassembled sequentially from the front body. These parts are checked with automatic inspection systems, the usable parts are washed, rechecked then reutilized intact as QuickSnap parts. Parts with defective functions or which cannot be used for other reasons are sent to the parts manufacturer or raw material supplier for recycling as raw material.

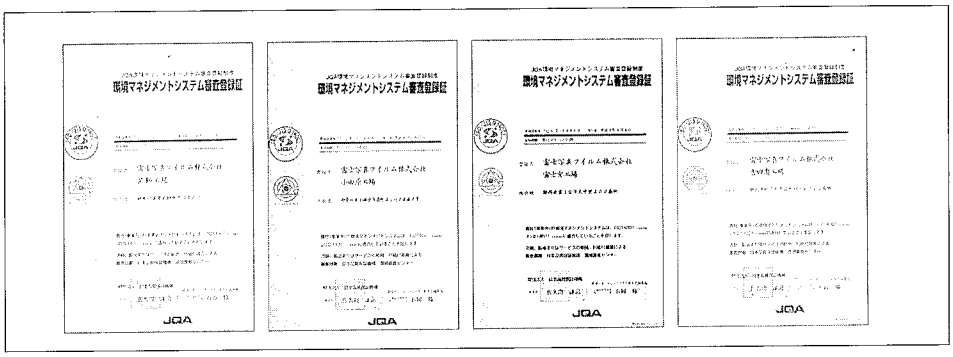
The systems and equipment necessary for this reuse and recycling technology were all developed by the company itself, and over 100 different patent rights have been acquired. The company regards this recycling system as a new type of production system for the 21st Century.

The center presently has a capacity to process 2,500,000 used cameras per month.

5. Environmental Management System

The factory uses various types of chemical substances and therefore adopts an all-out corporate policy to actively develop diverse production techniques and equipment to enable the discovery and use of alternative substances with minimum environmental impact, techniques for the evaluation and introduction of these alternative substances, techniques to minimize production waste generation, techniques for energy conservation and techniques for the recycling of recovered materials.

When the coordinated performances of the company's four domestic factories in 1995 were compared with those of 1990, it was found that the waste generation volume was reduced by 21%, materials recycled by an additional 7%, factory waste generation volume reduced by 19%, ultimate waste burial volume reduced by 69%, and the six domestic production plants attained an average recycling ratio of 72.5%.



ISO 14001 certifications

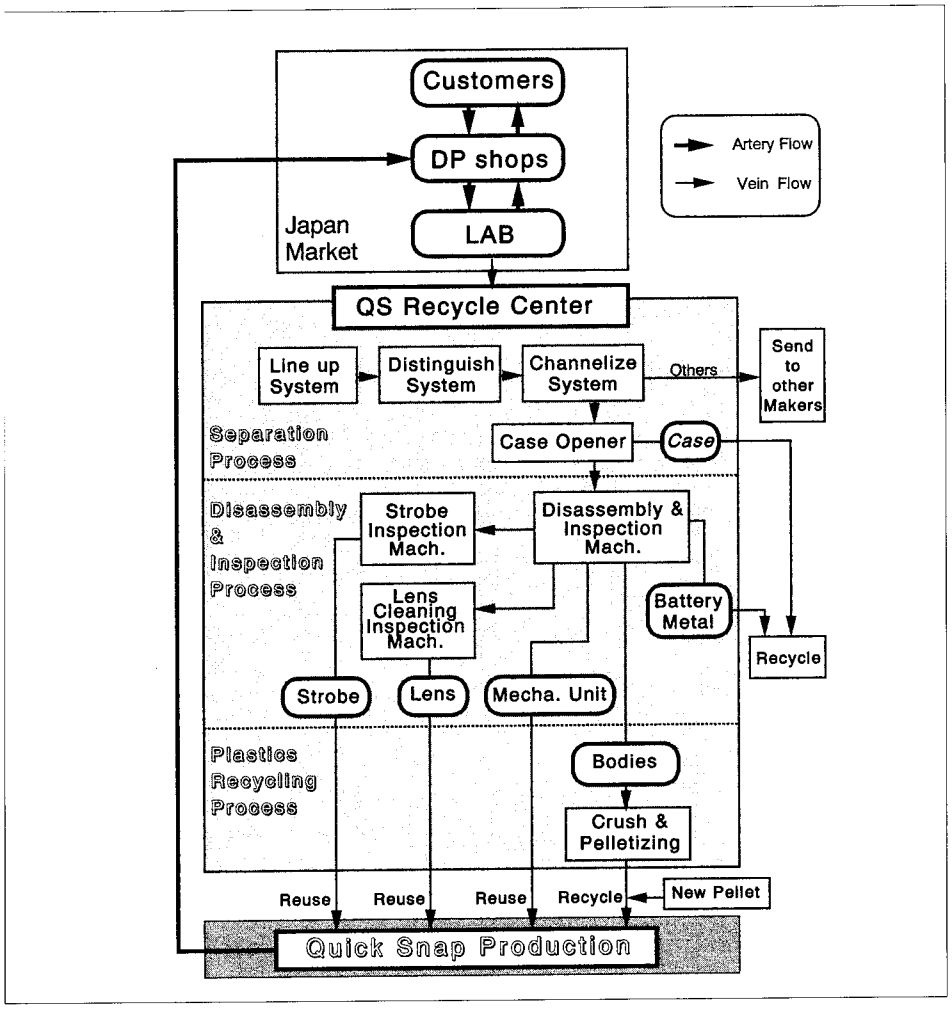


Fig.4 QuickSnap Circulatory Recycle Flow

6. Conclusion

The factory is regarded as one of the country's most advanced in the aspects of environmental preservation technologies and systems, and the company has established and applied diverse most advanced technologies to all of its manufacturing processes. The film production technology involves corporate know-how which cannot be divulged due to the need to preserve corporate technical secrecy, but the company's reverse manufacturing technology, including reutilization and recycling technology as well as environmental management technology merit study for application to other factories.

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TOPICS

This section describes selected developments of special importance or interest due to the achievement of a breakthrough or innovation in technology.

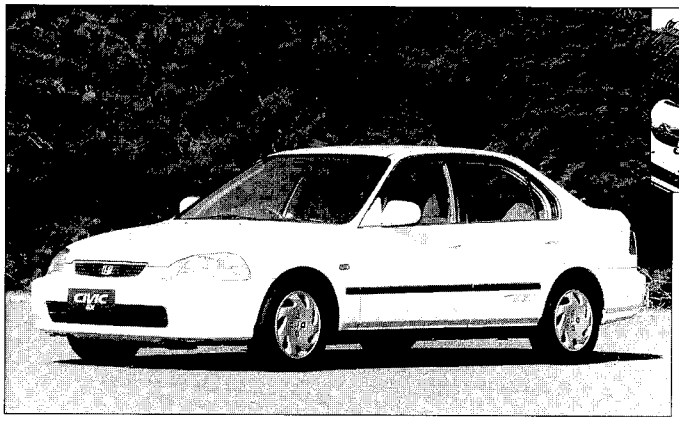
Natural Gas-powered Car Drastically Reduces Exhaust Emissions

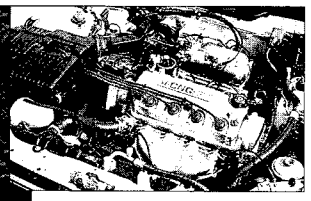
SINCE February 1997, Honda Motor Co., Ltd. has been conducting road tests of its newly developed natural gas-powered Civic GX prior to making it available to the general public. Running on compressed natural gas, this Civic GX emits drastically reduced levels of pollutants.

Natural gas intrinsically burns very cleanly and has the added advantage of being available in even larger quantities than petrol. It is already part of our everyday life in the form of city gas. Honda Motor has been researching natural gas vehicles for quite some time now, and by applying advanced proprietary technology, has been able to develop this Civic GX.

Civic GX uses a VTEC-E engine to combine dramatically reduced exhaust emissions with performance comparable to similar gasoline-powered vehicles. It introduces a unique all-composite fuel tank one-third the weight of an aluminum equivalent allowing a driving range similar to gasoline vehicles with up to 400 kms between refills. In addition, locating the tank deep inside the trunk provides for an adequate crushable zone in rear end collisions. Passenger safety is further increased with the adoption of a rigid body structure while mass production has been made possible by combining the tank, the high pressure plumbing and related accessories into one single module.

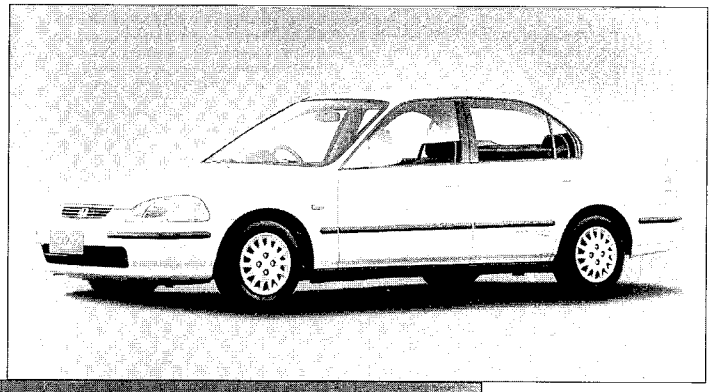
Honda is conducting road tests to verify the car's marketability prior to making it available to the public. This Civic GX, together with Honda's EV (Electric Vehicle) and LEV (Low Emission Vehicle), belongs to a family of environment friendly vehicles called Honda Clean Air Vehicles.



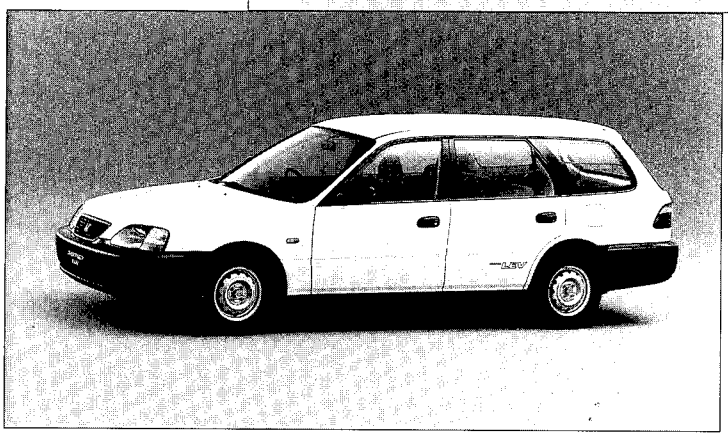


Engine outline

Civic GX



Civic Ferio LEV



Partner1.6 LEV

Main Technical Features of the Civic GX:

- VTEC-E engine for high power and low emissions
- High 12.5 to 1 compression ratio to take advantage of the high octane value of about 130 characteristic of Compressed Natural Gas (CNG)
- Safety valve technology acquired through Honda's Indy Car racing program
- High precision/high response electronically controlled multi-point fuel injection
- Compact, lightweight, high precision accumulative fuel pressure regulator
- All-composite CNC tank for lightweight and extended driving range
- Modular CNC tank construction for mass production capability
- Self-sealing tank orifice seal
- In-tank fuel supply breaker vane
- Rigid body structure and tank layout allowing adequate crushable zone

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Aluminum-alloy Sea Bird Passenger and Car-carrying Vessel

HITACHI Zosen Corporation recently completed construction of the Sea Bird, an 850-gross-ton passenger and car-carrying vessel, at the company's Kanagawa Works. The vessel was delivered to Yasuda Ocean Vessel Co., Ltd., in Nagasaki. Sea Bird was put into service on the domestic route between the ports of Nagasaki and Kushikino in Kagoshima Prefecture on April 18, 1997. This compact vessel can be berthed alongside any conventional wharves in Japan.

This 60-meter vessel is of the wave piercer class, jointly developed by Hitachi Zosen and Incat Design of Sydney, Australia, which is highly acclaimed in the high-speed boat design field. To date, more than 20 wave piercers have been built. The wave piercer design is based on the concept that the demi-hull bows cut through the waves rather than riding on top of them. This provides the vessels with greater seaworthiness, speed and comfort than conventional catamarans. High-speed performance is attained by the vessel's light weight, achieved through an original design and use of aluminum alloy.

Features of the Sea Bird include the following.

(1) Minimizing the buoyancy on the waterline at the side hulls' bows reduces wave impact on the vessel. This allows the bows to pierce waves easily. Accordingly, high-speed navigation is possible even in high waves and pitching is reduced.

(2) Between the catamaran's bows, the center hull provides auxiliary buoyancy above the waterline to prevent over-immersion in waves. Wave piercers are equipped a ride control system that consists of T-foils at the bow and trim tabs at the stern to improve passenger comfort.

(3) Four high-speed diesel engines and four propulsion water jets ensure high-speed performance and superior maneuverability.

The Hitachi Zosen design of the Sea Bird, like those of the Superjet-30 series, fully meet the requirements of a high-speed ship: passenger comfort, high-speed performance and fuel economy. The completion of the Sea Bird marks a milestone in Hitachi Zosen's history as a highly reputable shipbuilder.

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NATIONAL R&D PROJECTS

This section describes various R&D projects being carried out in Japan on a national scale.

Fuel Cell Power Generation Technology

1. Characteristics of Fuel Cell Power Generation Technology

Fuel cell power generation is expected to provide a new effective method for power generation since it features a variety of important advantages.

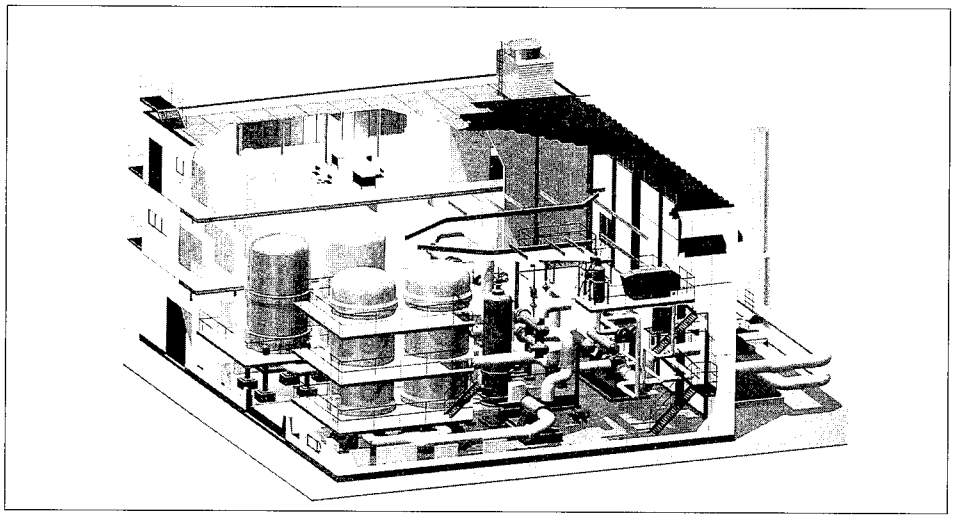
For example, it features the power generation efficiency is 40-65%, and the integrated energy efficiency may be as high as about 80% by utilizing the exhaust heat, emission of NOx and SOx is low, and the discharge of CO_2 can be reduced when the fuel cell comes into widespread use high power generation efficiency, so the fuel cell power generation system is gentle to the environment and contributes to the prevention of global warming, diverse types of fuels are usable such as natural gas, methanol and LPG, with the result that, depending on the type of fuel cell, the use of gasified coal will be possible, and since the system involves no massive rotary equipment such as turbine and generator, there will be less noise and vibration and the system can be installed even in urban regions without local opposition. Based on these diverse advantages, the fuel cell power generation system is anticipated as a promising global environment preservation type system to supply energy with stability for sustained social and economic growth.

2. Present Related Research

At present, three types of fuel cells are under research and development, specifically the molten carbonate fuel cell, the solid electrolyte fuel cell and the solid polymer type fuel cell.

(1) Molten Carbonate Fuel Cell

This fuel cell features a high power generation efficiency (45-60% at the sending end), uses gasified coal as its fuel and is therefore usable as a large-capacity power generation system for replacing existing thermal power generation systems. In addition, since it is operable at a high temperature (600-700 °C), it is also suitable for use in coordinated power generation systems.



Impression of the completed MCFC 1,000-kW power generation system

This system has been under research from FY 1981, a 100-kW stack as well as peripheral equipment were developed by FY1992, and research was started in FY 1994 to develop a 1,000-kW class power generation system. In FY 1997, the plan is to install and adjust peripheral equipment such as high-performance fuel reformer and high-temperature blower in a 1,000-kW class power generation system.

(2) Solid Electrolyte Fuel Cell

This type of fuel cell is anticipated to feature a power generation efficiency of 50-65% at the sending end, much higher than that of the molten carbonate fuel cell, and since gasified coal is usable as its fuel, the fuel cell replaces existing thermal power generation systems, also usable as a distributed type commercial power generation system (including use on isolated islands). In addition, since it is operable at a high temperature (900-1,000 °C), it permits effective utilization of exhaust heat is possible.

Basic research was started in FY 1981, a 400-W module developed in FY 1991, and research to develop a module of several kilowatt class was started in FY 1992.

(3) Solid Polymer Fuel Cell

This type of fuel cell features the highest output density (3 kW/m^2), can be fabricated in a compact and lightweight module, and since it is operable at a low temperature (60-100 °C), it displays an extremely fast startup and is therefore ideal for use as a portable and mobile power source.

Research on this fuel cell was started in FY 1992, and a 1-kW module developed by FY 1995. Starting from FY 1996, research is in progress to develop a power generation system of several dozen kilowatts.

Ceramic Gas Turbine Technology

1. Project Background, Objectives and Implementation

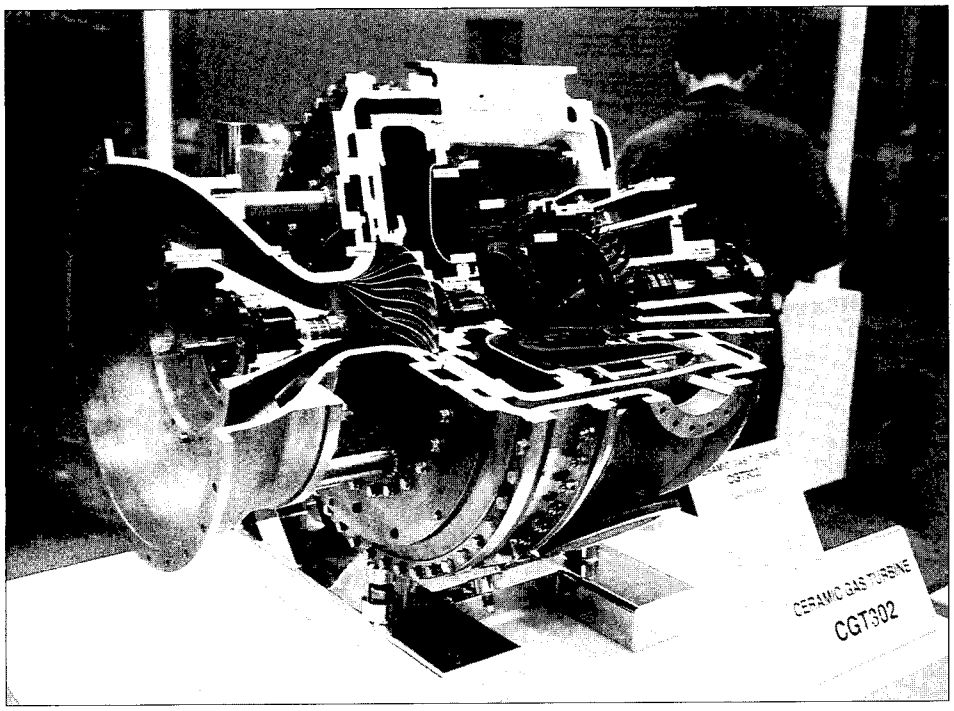
Research on the ceramic gas turbine technology is being advanced through an 11-year project (FY 1988-1998) as a link of the New Sunshine Program of the Agency of Industrial Science and Technology, Ministry of International Trade and Industry, with the objective of developing a 300-kW class ceramic gas turbine while establishing technologies for efficiency increased, air pollution reduction and fuel diversification.

In general, the gas turbine, compared with other thermal equipment, features various advantageous characteristics such as emission of exhaust gas of low NOx content, low noise and vibration, light weight, compact size (small installation area) and large output per unit weight, and capability of using various types of fuels. However, in contrast to medium- and large-sized gas turbines, compact gas turbines cannot be fitted with mechanisms for cooling the stationary and moving vanes. Therefore, a high temperature cannot be used for the turbine's inlet temperature, with the result that, with existing metal turbines, the turbine inlet temperature is only about 900 °C at the most, so emergency generators of 300-kW class for buildings have only a thermal efficiency of about 20%.

Research is in progress to develop ceramic gas turbine technologies with the aim of improving the efficiencies of these compact gas turbines, specifically with the objectives of using ceramic materials featuring excellent thermal resistances for turbine peripheral structural members to enable these turbines to be operated at higher temperatures.

2. R&D Schedule and Setup

Development of the ceramic gas turbine technology aimed at improving the thermal efficiency to over 42% by FY 1998 and to raise the turbine inlet temperature to 1,550 °C. Research will develop a heat resisting ceramic material featuring excellent high-temperature strength, toughness and corrosion resistance, basic technologies relating to combustors, turbines, heat exchangers and compressors made of ceramics, and design and experimentally fabricate a high-performance ceramic gas turbine.



Interior of the basic gas turbine model

In this R&D project, three types of ceramic gas turbines have been under development from FY 1988, and technologies relating to all these types are being developed primarily under the leadership of turbine manufacturers and material manufacturers. In FY 1994-1995, an interim evaluation was conducted primarily of the performances of the ceramic gas turbines developed so far, with the result that it was decided that future

R&D activities would be concentrated with the ultimate target focussed on developing two types of ceramic gas turbines by FY 1998. Presently under development is a regenerative uniaxial CGT (Model CGT 301) and a regenerative type biaxial CGT (Model CGT 302), both for use in coordinated power generation.

3. Present Progress

The establishment of ceramic gas turbine technologies was not initiated by using gas turbines made of ceramics from the start. In the initial stage, research was conducted to clarify the propriety of the engine system by assessing the compatibilities among various related elementary parts by using a basic gas turbine made of metal and displaying a turbine inlet temperature of 900°C. Subsequently, research was advanced with a basic gas turbine made of ceramics and turbine inlet temperature of 1,200°C.

At present, based on the results of these research projects, research is in progress on a pilot ceramic gas turbine with a turbine inlet temperature of 1,350°C, and the turbine is to enter intensive running tests. Incidentally, as of the end of FY 1997, a basic model of a ceramic gas turbine with a turbine inlet temperature of 1,200°C attained a high thermal efficiency of 37% for the world's first time.

4. Vital Themes of Research in FY 1997

Intensive running tests of the pilot ceramic gas turbine are to be conducted during FY 1997, while in parallel, R&D is to be advanced to develop excellent heat-resisting ceramic structural materials and be basic technologies. Also, setting the ultimate targets will vital when engaging in running tests, so based on the progress and results of these running tests, further tests are to be continued under actual running conditions with the objective of improving the reliability of the entire ceramic gas turbine system.

GENERIC TECHNOLOGY REVIEW

Study on the Quantum Control of Chemical Reactions
Selective Conversion of Light Alkanes over Heterogeneous Catalysts
Research on Activation of Inter-heteroatom Bonds

This section describes various basic research and development activities in Japan to inform the world about generic R&D efforts here.

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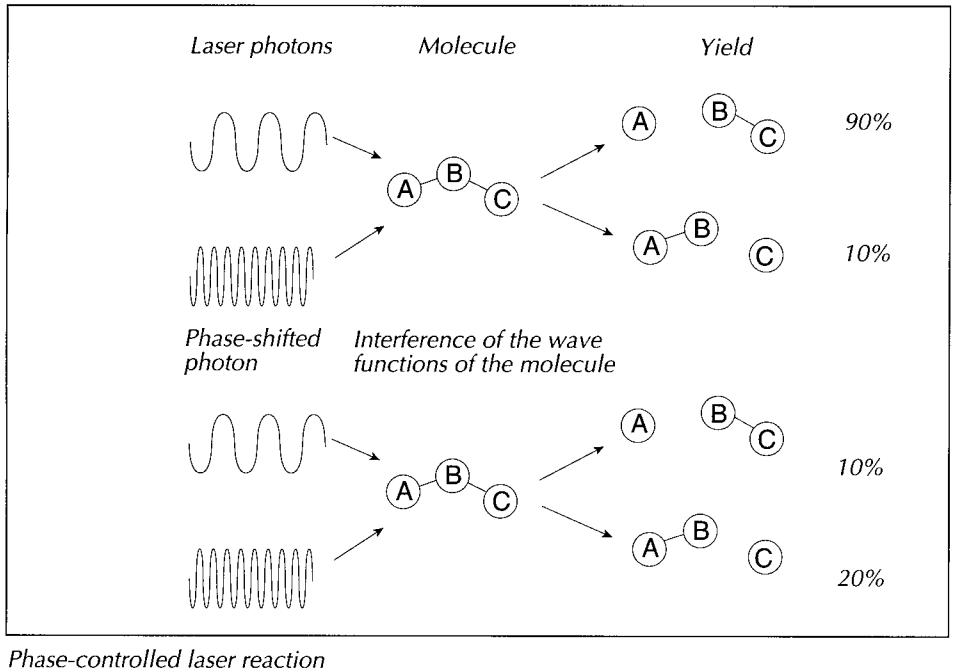
Study on the Quantum Control of Chemical Reactions

National Institute of Materials and Chemical Research

Various kinds of materials are produced by chemical reactions. The paths, rates, efficiencies and products of the reactions are affected by temperature, pressure, concentration, etc. In order to obtain desired materials with desired efficiencies, the reactions have been controlled by changing these macroscopic conditions. Quantum control of chemical reactions is a technology to control the reaction by controlling the movements of (microscopic) quanta such as electrons, atoms, etc. In the present study, the possibility of quantum control of chemical reactions will be examined.

For many years, attempts have been made to control chemical reactions by lasers utilizing the high intensity or excellent monochromaticity of the beams, but they were mostly unsuccessful. However, recent developments of laser technology and theory of chemical reactions have made quantum control of chemical reactions more realistic. It has already been shown theoretically that, by using two or more coherent laser beams, the ratio of the products of a reaction can be changed by changing the phases of these beams.

The present study will be carried out using the fundamental and the third harmonic beams of a laser whose intensities and phases can be changed. By exciting the reactants by these beams, the possibility of changing the ratio of the products will be examined, and the reactions will be identified to which this method of control can be applied. The method of quantum manipulation will be developed for that purpose. At the same time, the mechanism of the simplest chemical reaction, electron transfer, will be studied by ultrafast spectroscopy and by theoretical methods to examine the possibility of controlling the reactions.



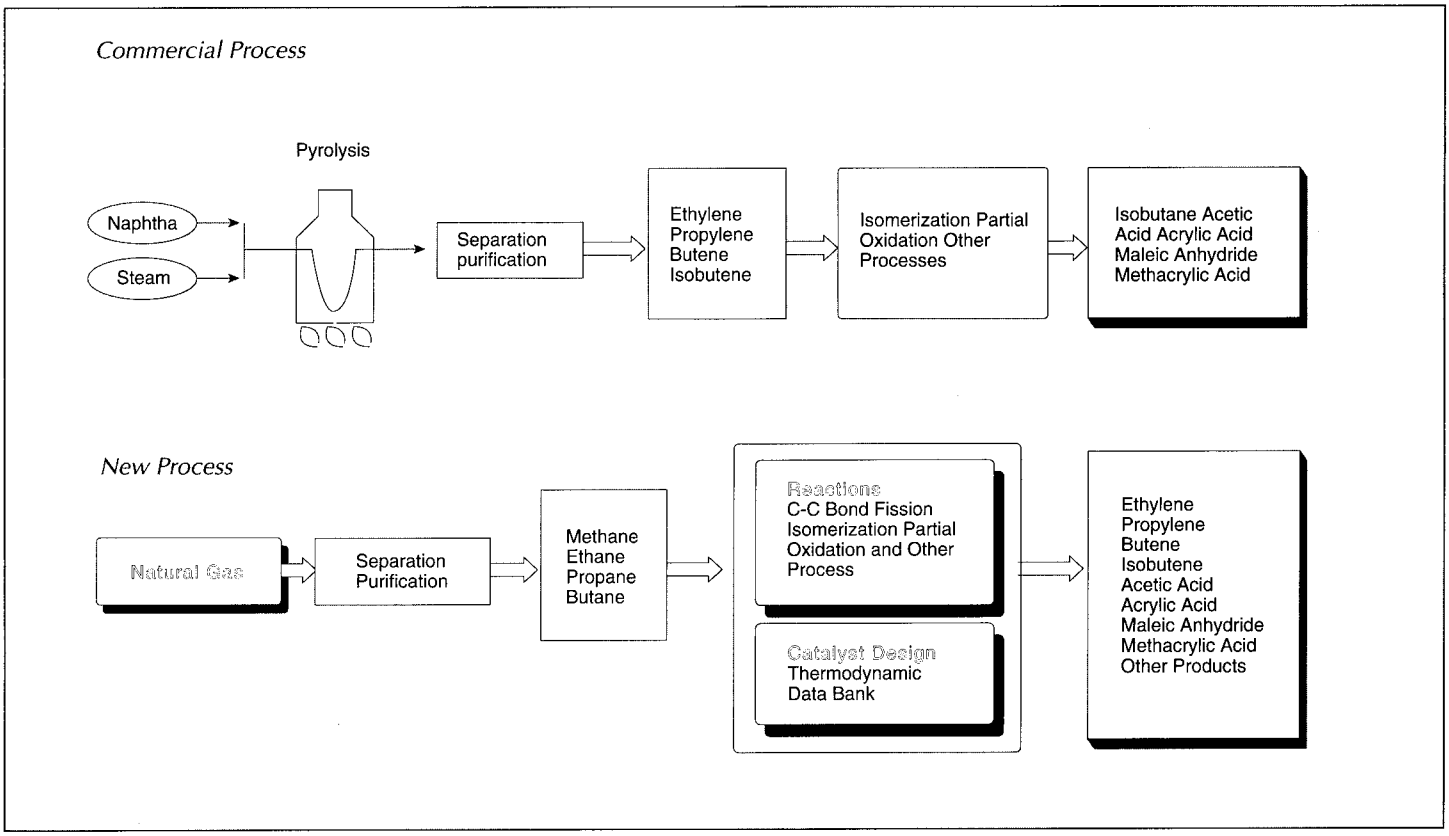
Phase-controlled laser reaction

Selective Conversion of Light Alkanes over Heterogeneous Catalysts

National Institute of Materials and Chemical Research

Natural gas is an abundant and inexpensive hydrocarbon resource. In the future, the petrochemical industry will probably move to the direct use of alkanes, obtained from natural gas. Therefore, there has been great interest in direct conversion of light alkanes to more useful chemicals. These reactions involve the oxidative fission of carbon-carbon bonds, structural isomerization, and partial oxidation.

This research will develop the reaction mechanism and the catalyst design. Alkane conversion involves the isomerization of n-butane over solid-acid catalyst and the partial oxidation of methane over transition metal oxide catalysts and other reactions. One of the purposes of this research is to elucidate the mechanism of these reactions. The second approach is to design metal oxide catalysts in support of a thermodynamical data bank. According to the design, catalyst preparation from catalyst precursor-containing water solution will be carried out. The final goal of this research is to establish the best catalyst preparation method for the alkane conversion.



Research on Activation of Inter-heteroatom Bonds

National Institute of Materials and Chemical Research

Objectives and Outline of the Research

Transition metal complex catalysts play important roles in the organic chemical industry. For example, acetic acid is now produced by the rhodium complex-catalyzed reaction of methanol with carbon monoxide. Newer processes to produce polymers such as polyethylene and polystyrene are also based on metal complex catalysts known as metallocenes. In view of the high selectivity and the mild process conditions, the catalysts will be even more important. However, applications of the metal complex catalyst to manipulation of so-called heteroatom compounds, which are the compounds that contain group 13-16 elements, are very few to date. Heteroatom compounds are believed to be useful for creation of new materials and new selective synthetic reactions. The objective of this research program lies in the creation of new chemistry of the heteroatom compounds, aiming at future practical applications in the fine chemicals industry.

This research program involves the following themes.

1) Creation of Heteroatom Compounds

The variety of compounds that have heteroatoms is limited. Those that have bonds between two heteroatoms are even more rare and many of them are thermally unstable. Accordingly the first step of the research is to create new heteroatom containing compounds and to look into the chemical behaviors. Emphasis will be placed on the compounds of boron, aluminum, gallium, silicon, germanium, tin, phosphorus, bismuth, selenium and tellurium.

2) Reactivities of Interheteroatom Bonds

Interaction of transition metal complexes with various interheteroatom bonds will be studied to explore the complexes that are able to cleave the bonds. To promote the possible cleavage, the nature of the metal complex has to be tuned by changing the ligands, sterically and electronically. Depending on the nature of the complex, the cleavage can be reversible. Alternatively, metal complexes that have organic groups bound to the metal center will be used in the reactions with the interheteroatom bonded compounds. In this case the organic groups will be displaced by the heteroatom to generate heteroatom-transition metal species. Structures of the resulting species from these approaches will provide information about the nature of the bond between the transition metal and the heteroatom.

3) Reactivities of the Resulting Species

The resulting species will be treated with various unsaturated compounds such as olefins, dienes and acetylenes. These compounds may insert into the heteroatom-metal bonds to generate new species. Depending on the system, cumulative insertion may take place. The products of the insertion process will be structurally characterized. The stability and the reactivity of the products will be studied to gain information to design new catalysts.

4) Design of New Catalysts

Combining the foregoing results together, catalytic synthetic reactions will be designed. Major emphasis will be placed on syntheses based on insertion of unsaturated compounds into interheteroatom bonds. The nature of the transition metal, ligand and solvent has to be optimized to realized new synthetic reactions.

5) Heteroatom-Containing Polymers

Polymers containing heteroatoms may exhibit interesting properties, such as non-linear optical properties, electric conduction, photo-reactivities, etc. In view of these, polymers will be designed and synthesized based on the reactivities of the interheteroatom bonds and of the heteroatom-transition metal bonds. Properties and functions of the resulting polymers will be clarified.

97-07-100-01

Monocrystalline Potassium Niobate as Material for SAW Filter

Prof. K. Yamanouchi and a research team at the Research Institute of Electrical Communication, Tohoku University have demonstrated that monocrystalline potassium niobate ($KNbO_3$) exhibits excellent properties very suitable for a surface acoustic wave (SAW) filter. The material converts an electrical signal into a mechanical wave so efficiently to allow a SAW filter with a wide passband enabling the filter to handle a rapid stream of data. The $KNbO_3$ SAW filter promises to serve for the next generation of radio communications including portable videophone systems and high-speed radio LANs (local area networks).

A SAW filter consists of a piezoelectric plate with a pair of electrodes spaced by a distance on the plate. An input electrical signal is converted into a mechanical wave at one electrode, and the wave propagates along a surface of the plate, and is converted back to an output electric signal. During the process, frequencies other than a certain band are filtered out. The device is popular as a key component of cellular phones and other electric articles.

In the current trend toward greater data rates in communications, the passband of a SAW filter must be widened. Engineers have been seeking a piezoelectric material of a higher conversion efficiency. The research team studied the piezoelectric properties of $KNbO_3$, which is a nonlinear optical material generating harmonics of incident light. They found that $KNbO_3$ single crystals have an electromechanical coupling coefficient (conversion efficiency) of 0.53, about ten times as much as the value for lithium niobate ($LiNbO_3$) of 0.055. The research team built a prototype $KNbO_3$ SAW filter, and ascertained that it had a passband 6 times as wide as a conventional SAW filter. Another feature of $KNbO_3$ is that the temperature characteristics have a null coefficient around room temperature. This implies that the $KNbO_3$ SAW filter allows stable operation in the normal temperature range.

The new SAW filter may lead to implementation of a cellular phone system carrying video data. Another possible application is forthcoming digital radio transmission systems including the spread spectrum communication. The research team is now developing a film process of the material and other techniques for industrial application.

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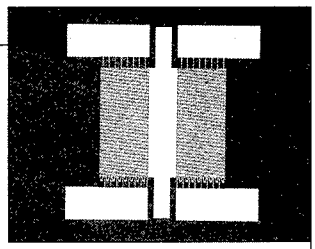
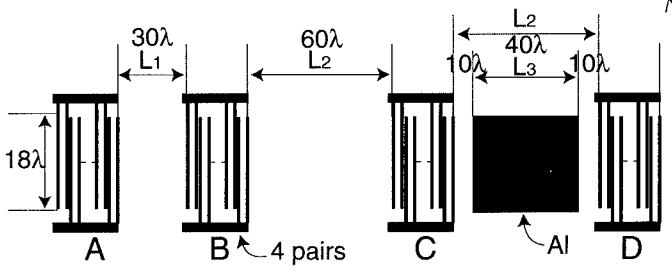


New SAW filter



Electrode structure used in the experiment

97-07-100-02

Glass Ceramic Resistant to Temperatures of 1,800 °C

Noritake Co., Ltd., jointly with Prof. N. Arai and K. Kobayashi of the Research Center for Advanced Energy Conversion of Nagoya University, have developed a glass ceramic (patents pending) having an excellent thermal resistance of endurance under direct heating at a temperature of 1,800°C. This material has a morphology of intermetallic compound, coated with purified silica, which is homogeneously dispersed in thermally resistive glass matrix. Coating ceramics and metals in general with this glass ceramic enables the heat resistance of these materials to be improved considerably, and enables the costs of these materials to be slashed to less than one-half.

Alumina is a typical type of heat resistant ceramic and has an emittance of about 0.3 at 1,800°C, but the emittance of this new glass ceramic is over 0.8%. This high level of emittance is retained with stability up to a high temperature, so that the heat resistance is improved considerably. In addition, the glass ceramic can be coated onto ceramics and metals with ease.

The new silica coating material can be applied not only to plastic materials to manufacture the components of advanced energy conversion equipment such as engines and gas turbines, but also to the manufacture of paints for cooking utensils and construction materials. Today, the limit inlet temperature heat resistance of gas turbine engines is 1,350°C, which is attained by using a cooler. Coating this glass ceramic onto gas turbine parts enables these parts to be used at temperatures as high as 1,800°C, by which the engine theoretical thermal efficiency will be improved by about 10%.

This glass ceramic material is a key material contributing to the establishment of energy-saving technologies, and further research will evaluate the new material characteristics and applicability, and market surveys will assess the prospects for commercialization.

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97-07-100-03

Three Nitric Acid-Resistant Alloys

The Tokai Research Establishment of Japan Atomic Energy Research Institute has developed three new alloys resistant to nitric acid. The alloys have different acid-resistances to cover various stages in the Pulex type reprocessing process of spent nuclear fuel.

Nitric acid solution is used everywhere in a reprocessing facility of spent nuclear fuel, and is subject to parameters and conditions largely changing from stage to stage so that its oxidizing ability and corrosive power vary greatly. Some pieces of facility equipment must withstand the strongest acidity and corrosiveness, and may be expensive, but not others. In reprocessing facilities, acid strengths can be classified into three ranges of the oxidation potential (low, middle, high). Many types of equipment materials should be designed with properties suitable for the ranges of corrosion resistance required.

A new material with greater acid resistance was also needed for the stage of dissolving spent nuclear fuel, where the acid solution is more corrosive for greater efficiency. Nitric acid should contain a small amount of hydrofluoric acid to magnify the oxidation ability. Unfortunately, the mixed acid is too corrosive for all conventional equipment materials, and corrodes zirconium (Zr) alloy easily, the most acid-resistant type. An acid-resistance reinforced material will allow the strongest acid to be used in plants.

Tokai Research Establishment investigated the corrosion of alloys under the conditions found in reprocessing facilities. The results allowed the development of three types of alloys for the low, middle, and high ranges of acid strengths. For the low acid strength range, stainless steel was modified to have a carbon content of one third as much as the conventional steels, which suffer from severe attack by oxidizing nitric acid. The new stainless steel is so pure that there is little grain boundary to be attacked. A 1,000-hour corrosion test proved that the new alloy is corroded at less than one-third the rate of the predecessor.

The new alloy for the middle range is a nickel (Ni) alloy containing chromium (Cr), tungsten (W) and silicon (Si). With the various ingredients, the alloy forms a passive oxide film with a composition optimum for resistance to corrosive environment at any point in the whole middle range of acid strength. It can be used in many parts of the facility equipment.

The most acid-resistant of the new alloys is a niobium (Nb) alloy containing 5–10% tungsten. The Nb-W alloy withstands the nitric acid containing hydrofluoric acid, and will cost less than the conventional zirconium alloy because Nb is cheaper than Zr. The Nb-W alloy may be suitable for reprocessing MOX (mixed oxide) waste, a mixture of uranium and plutonium oxides.

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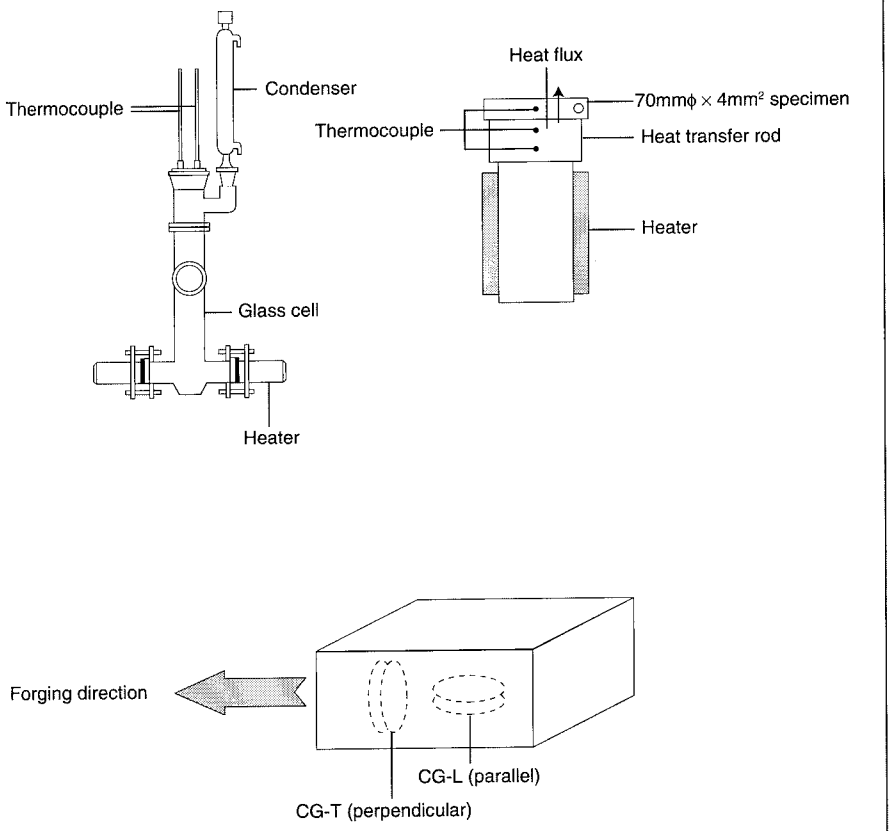


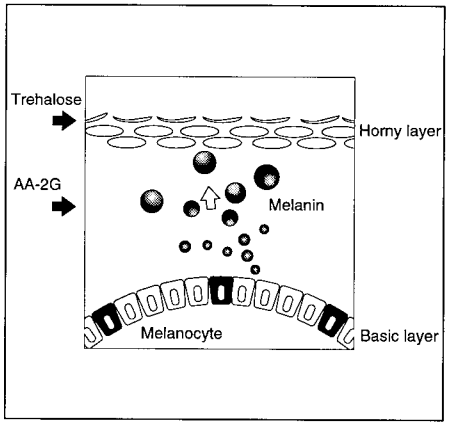
Schematic view of a corrosion test device used for the present study

97-07-100-04

Medical Cosmetic Acting Directly on Cells for Beautifying the Complexion

H + B Life Science of the Hayashibara Biochemical Laboratories, Inc. and Prof. Yamamoto of the Faculty of Pharmacy, Okayama University, have jointly developed the medical cosmetic SCICLAIR which consists of the natural complexion-retaining vitamin C (ascorbic acid 2-glucoside) and the natural moisture-retaining substance trehalose, intended to help maintain a beautiful complexion by working directly with the outer layer of the skin surface and the cells below this layer.

Vitamin C effectively prevents stains and freckles caused by sun tanning. Vitamin C acts directly on the pigment-generating cells (melanocytes) lying underneath the outer layer of the skin and suppresses the generation of melanine pigments which are the causes of stains and freckles. However, vitamin C is rather unstable substance and destroyed quickly when blended into costmetics, the substance cannot display its effect.



Cross-section of sunburnt skin

The natural complexion beauty-retaining vitamin C (ascorbic acid 2-glucoside) is a new type of highly stabilized vitamin C that solves the problem of instability of natural vitamin C. Ascorbic acid 2-glucoside is decomposed into vitamin C and grape sugar inside the body due to enzymic action. Further, since the decomposition proceeds slowly, the beauty cosmetic achieves a sustained effect. Trehalose is a type of natural saccharide and is a remarkable substance relating to the resuscitation phenomenon in drying plants and apparently dead small animals, which regain their activities with a drop of water. This is due to the excellent properties of trehalose to protect vitamins from excessive drying or freezing. The life science research institute has succeeded in establishing a setup for the mass production of trehalose and blended the substance into SCICLAIR that is designed to give moisture to the skin and to retain a smooth complexion. The mass production setup was developed by applying the consortium's advanced enzyme technology, and patent rights are presently pending in 26 countries worldwide.

The medical complexion beautifying cosmetic developed this time is available as a whitening cream, whitening lotion and face washing liquid. The lotion is available in the refreshing type and the dampish type, or usable in conformance with the user's complexion. These products are used in a three-step process for the face washing liquid for removing dust and waste facial substances, the whitening lotion for preparing a fair complexion, and the whitening cream for maintaining the skin in soft and radiant state.

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97-07-100-05

Titanium Alloy Coloring Technology

The Technology Research Institute of Osaka Prefecture has developed a titanium alloy coloring method by using wire-electrical discharge machining (EDM) process without any other post treatment.

Generally, titanium alloy coloring techniques such as the atmospheric oxidation or the anodic oxidation methods require shape machining to be performed first, and followed by coloring in the separate process. The new technology is attracting attention as an effective method for design improvement that substantially increases the values of titanium alloy products.

With this new technology, the requested colored surface is obtained during the finishing EDM process. During this process, a molten and resolidified surface created by arcing discharge is colored directly by the anodic oxide formation in the dielectric water. The thickness of the oxide layer is conceived to determine the ultimate color tone, so it can be possible to give titanium alloys various kinds of colors by controlling the average working voltage.

Titanium has enormous strength and excellent corrosion resistance, so it is used widely in various fields. The new method will present the wider use of titanium alloy products with more increased values, such as spectacles, watches, bicycle parts, sporting goods and so on.

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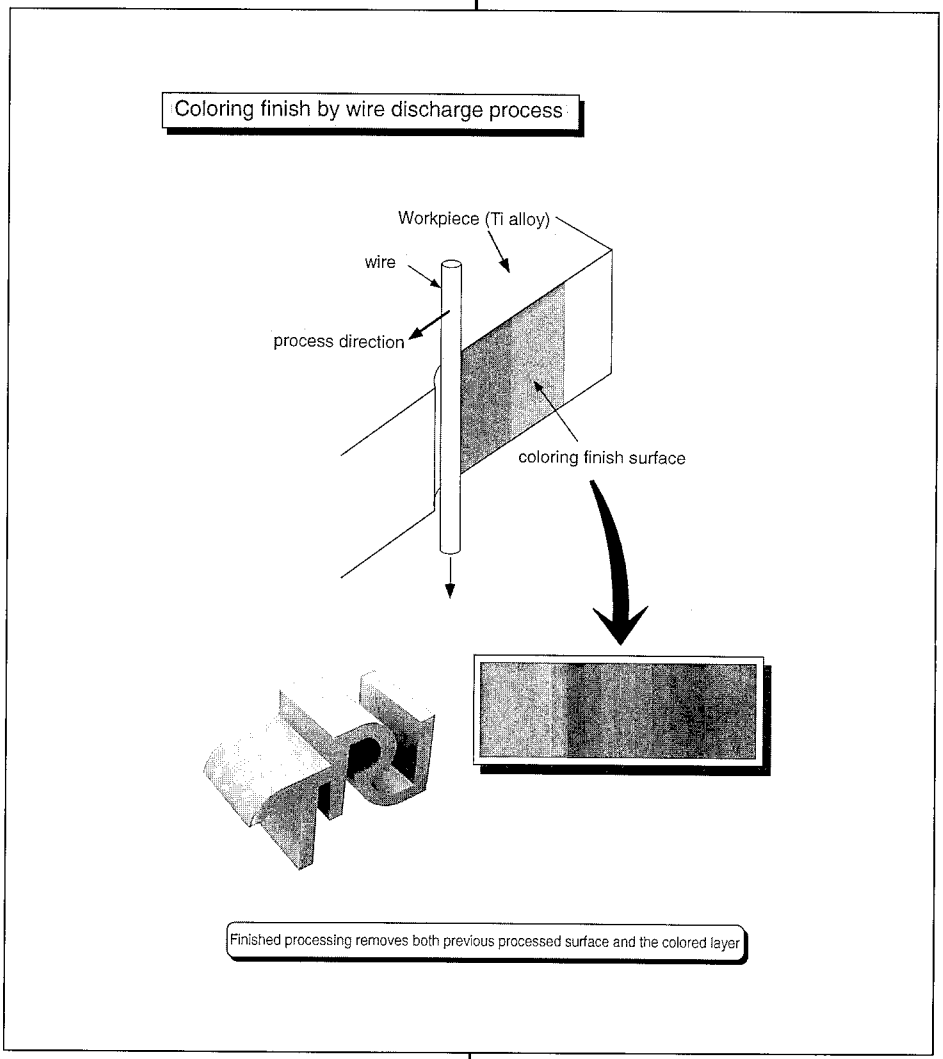

NEW TECHNOLOGY & PRODUCTS

This section provides information about recently developed technologies and products, divided into Advanced Materials, Electronics & Optics, Information & Communications, Process & Production Engineering, Construction & Transportation, Energy, Environment, and Biotechnology & Medical Science.

Advanced Materials

97-07-001-01

World's Strongest Stranded Steel Wire for Prestressed Concrete

Kobe Steel, Ltd. and Shinko Wire Company, Ltd. have jointly developed the world's strongest stranded steel wire for prestressed concrete (PC). The tensile strength has been increased to the 2,300-N (Newton) level, or about 20% greater than the strongest previous stranded wire with a strength of 1,900 N/mm^2.

The prestressed stranded steel wires are used to strengthen concrete structures. When a prestressed concrete structural member is placed under a load, the tensile strength of the steel wire returns the structural member to its original state. Therefore, prestressed concrete is used when building bridges or floors required to carry tremendous loads. Stranded steel wire is produced by stranding wires with diameters of 4-5 mm and is available in a 7-wire bundle in which one wire is used as the core and six others are wound around the core wire, A 19-wire stranded version is also available. The domestic PC stranded wire market requires 50,000-60,000 metric tons annually.

The construction industry has recently come to use prestressed concrete of increasing strengths from the previous 4,400 N/cm^2 to 6,000 N/cm^2. If existing stranded steel wires were used, the number of constituent wires would have to be increased or the spans of the structures (which are generally 50 m in length) would have to be shortened. The research team solved this problem by increasing the tensile strength of the stranded steel wire.

Normally, when the tensile strength of a wire is increased, the toughness (flexibility) and ductility deteriorate. The research team attempted to increase the strength without reducing the other properties. The steel wire structure consists of laminated layers of ferrite (pure iron) and cementite, a compound consisting of iron and carbon. The gap between the layers was reduced to the nanometer level, one-tenth compared with before, and silicon pycnosis (concentration) was achieved at the surface boundary between cementite and ferrite, while stabilization techniques were optimized, thus enabling the development of the high-strength stranded steel wire .

The 20% strength increase enables the number of wires to be decreased by 20% while giving the prestressed concrete the same strength. It also enables the bridge spans to be increased by 20%, in addition to decreasing the consumption of concrete and reducing the time and labor for tensioning the stranded steel wires.

The company has started distributing samples of the new stranded steel wire, and anticipates application in bridges and other large structures.

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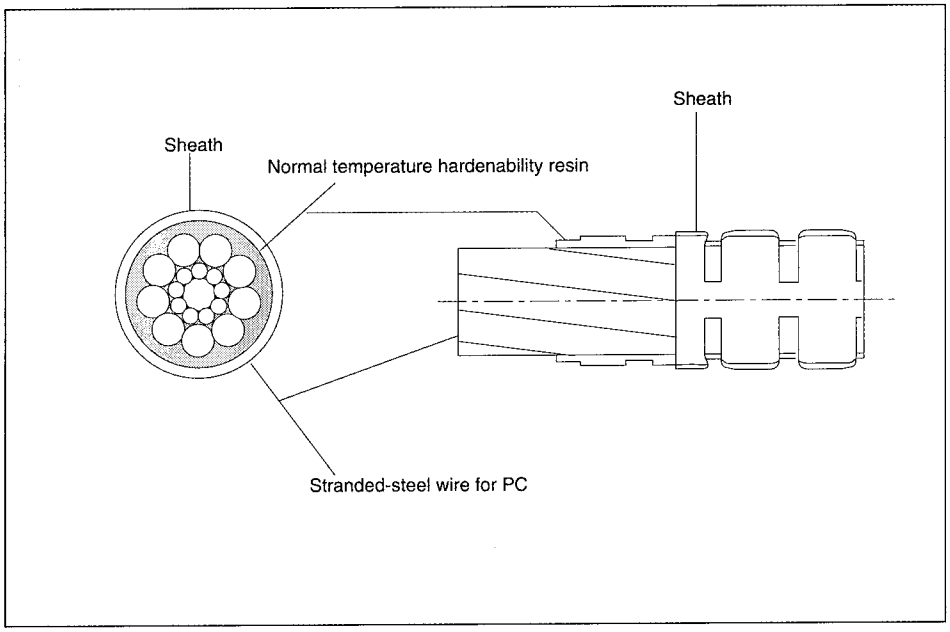

Afer bond PC steel

97-07-001-02
Kuralon K-II Water-Soluble Spun Yarns

Kuraray Co., Ltd., has developed water-soluble yarns as product variations of its new synthetic fiber, Kuralon K-II. These endeavors have reached fruition with the marketing of the Super Soluble series.

The company began to investigate the market for Kuralon-II in April 1996. Emphasizing its water-solubility, Kuraray has focused on expanding its use in fiber, yarn, fabric and non-woven fabric applications. Of these, the area of yarns displays great potential. Consequently, Kuraray will start full-scale marketing of a host of general-purpose products.

The Super Soluble series comprises high-strength, water-soluble PVA fiber of homogenous quality. It was realized through the solvent wet cooled gel spinning of Kuralon K-II. While water-soluble, the series is stable under various humidity conditions. It also features a range of dissolution temperatures, supporting a variety of applications. The strength of the series is adequate for industrial uses, while it is nontoxic and biodegradable, minimizing the burden on the environment. Moreover, fine yarns can be produced that were not possible with conventional water-soluble fibers.

The company has high expectations that the range of applications for the Super Soluble series and of Kuralon K-II will continue to expand.

Kuralon K II products

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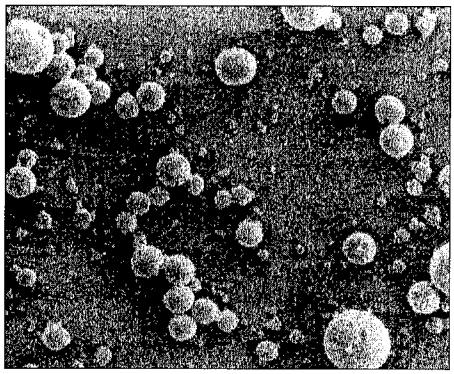
97-07-001-03
Hyperpure Spherical Alumina Powder

Admatechs Co., Ltd., a manufacturer of fine ceramics raw materials, has established a combustion synthesis process technology to manufacture ceramic powders from metal in an oxidized gas flow, and has developed and started distributing samples of a hyperpure alumina powder with extremely low alpha particle ray emission.

Alumina features a high heat conductivity and is excellent for use as a filler for semiconductor sealing resins, but the high alpha particle ray emission causes problems. The new hyperpure spherical alumina powder is available in two types with average particle diameters of 6-13 μm and 0.5-1.0 μm. The alpha particle ray emission is extremely low at only about a hundredth that of conventional types of alumina, or comparable to that of silica. The hyperpure spherical alumina powders will be useful as sealing resin filler for highly integrated semiconductor.



Hyperpure spherical alumina powder

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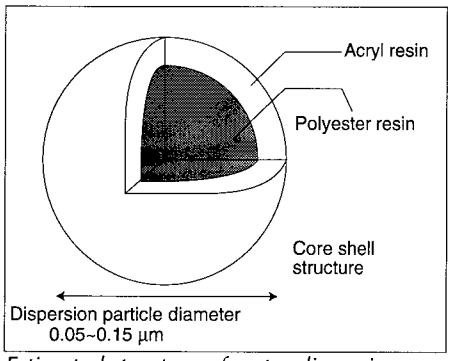
97-07-001-04
Acrylic Modified High Polymerized Resin for Water-Soluble Paints

Toyobo Co., Ltd. has developed an acrylic modified resin for water-soluble paints. Acrylic modified polyester grins with diameters of about 0.07 μm are easily dissolved in water to render the grains hydrophilic and usable for commercializing



Estimated structure of water dispersing element

paints and adhesives which utilize water as the solvent and which do not require organic solvents such as thinner and toluene.

The new resin is an acrylic denatured high polymerized polyester that is dispersed in water readily and available in the TAD Series (tentative name) with core shell structure. The molecular structure incorporates a polyester monomer that is affinitive with acryl to promote its chemical reaction with esters and acryls.

Since acryl is hydrophilic, the resin grains are dispersed readily in an aqueous solvent. When the resin is dried and the water vaporized, the grains bond with each other to allow use as a paint or an adhesive. The resin will be sold at domestic price of ¥500-1,000/kg, and the company plans to distribute samples of the resin within the year.

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97-07-001-05
Synthesis of Biodegradable Plastics Using Synthesis Gas ($CO + H_2$)

The National Institute of Materials & Chemical Research and the Research Institute of Innovative Technology for the Earth (RITE) have jointly established a new synthesis process that uses synthesis gas ($CO + H_2$) and its derivatives for the sustained manufacture of aliphatic polyester-based biodegradable plastics that is observed as a promising polymer raw material for use into the 21st century.

Our existing economic and living mode based on mass production as well as mass

consumption and disposal is being necessarily reassessed from the need of utilizing natural resources effectively and preserving our living environments, and the development of technologies conducting to the establishment of a sustainable society has become a major issue of mankind in our advance into the 21st century. Even in the polymer chemical industry, the establishment of technologies for the sustained manufacture of plastics has become a major theme of research.

Research is presently being advanced actively in the United States, Germany and Japan to establish waste plastics and biomass gasification technologies. Synthesis gas ($CO + H_2$) and its derivatives which can be obtained through the vapor treatment of diverse ingredients which are available in sustainable volumes, such as the incineration gases of waste plastics contained in city refuse, biomass that is a regenerative resource, as well as coal and non-fossil carbon resources, are usable as the raw materials in place of petroleum, and the existing state dictates an effective utilization of these polymer synthetic raw material into the future.

In this research project, a new synthesis process was established to manufacture a polybutylene succinate-based biodegradable plastic featuring greater mechanical strength than low-density polyethylene that is presently being used universally, by utilizing carbon monoxide, methanol and other raw materials which are available in sustainable volumes as the raw materials.

The aliphatic polyester is generally synthesized by dehydrated condensation polymerization of raw materials such as dicarboxylic acid ($HOCOR_1COOH$) and diol (HOR_2OH), but a problem exists with its lack of polymer weight, so studies are being advanced to utilize molecular chain linkage agents as additives (nitrogen compounds, etc.) with the aim of increasing the molecular weight and to improve the substance's properties. The chemical equation for this is:

$HOCOR_1COOH + HOR_2OH$ + additive —> polyester copolymer + H_2O (1)

In this research project, dimethyl succinate that is available in good yield through the hydroesterization reaction shown by equarion (2), established through this joint research conducted so far, was used as the dicarboxylic acid raw material, and a macromolecular aliphatic polyester was synthesized through a demethanol reaction differing from the dehydrated condensation polymerization of equation (1).

$CH_2 = CHCOOCH_3$ (Methyl acrylate) + CO + CH_3OH (Methanol) —> $CH_3OCOCH_2CH_2COOCH_3$(Dimethyl succinate) (2)

$nCH_3OCOCH_2CH_2COOCH_3$ (Dimethyl succinate)+ $nHO(CH2)_4OH$ (Butanst) —>{-$COCH_2CH_2COO(CH_2)_4O$-}n+ $2nCH_3OH$ (Polybutylene succinate)(3)

The average molecular weight of the obtained polyester exceeded 40,000, and the methanical strength was greater than that of polyethylene available on the market. Various types of soils were used to conduct soil burial tests of the obtained polybutylene succinate, which corroborated that a microbe exists in the soil featuring excellent biodegradation function with respect to this polyester. In addition, it was learned that the biodegradability of polybutylene succinate can be controlled by copolymerization of polybutylene succinate and oxygen compounds such as carooxylic acid and ether compounds which are obtained as derivatives from the synthesis gas.

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Electronics & Optics

97-07-002-01

Conformance to CE Marking Low Voltage Directive of AC Servo Drive "SIGMA Series"

Yaskawa Electric Corp. has developed production and begun the sales of its AS servo drive and general purpose inverter, conforming to European safety standards. Since January 1, 1997, conformance to the "Machine directive", "EMC directive" and "Low voltage directive" are compulsory for all industrial machines set up in the member states of the European Union (EU).

From an early stage, Yaskawa has worked to ensure that the mechatronic equipment products conform to the "Machine directive" and "EMC directive". Now, by additionally ensuring that the AC servo drive "SIGMA series" and "General purpose inverter", which are representative mechatronic equipment products, conform to the "Low voltage directive", the company increasing their recognition in Europe as safe industrial electrical products and expanding exports.

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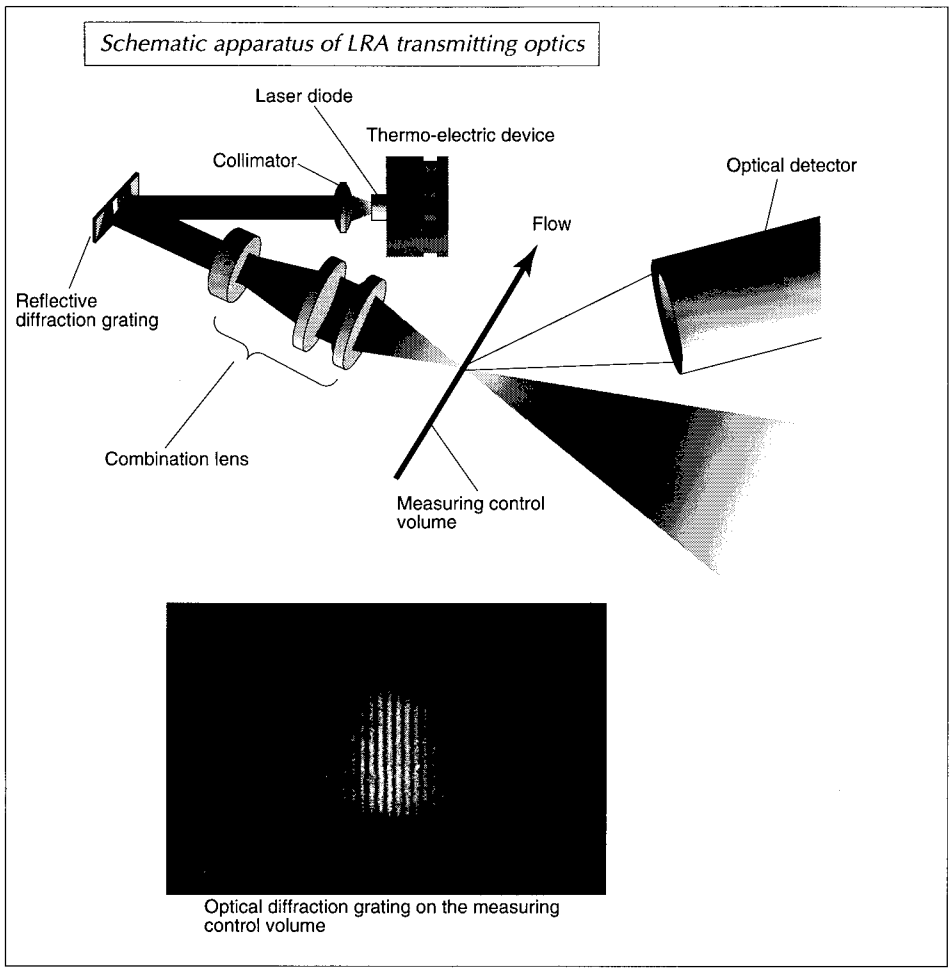
97-07-002-02

Laser Resonance Anemometer

The National Research Laboratory of Metrology, a subsidiary of the Agency of Industrial Science and Technology (AIST), has developed a very inexpensive laser flowmeter. Making the best use of an oscillating feature of cheap laser diodes (LDs), the new anemometer has a simple configuration to ensure accurate measurement.

Various flow instruments use an artifact of flow for measurement. For example, a hot-wire anemometer places a hot wire in a flow to determine the rate at which the wire is cooled down by the flow. Another type observes the periodicity in a Karman vortex street caused by an obstacle in a flow. Those conventional flow instruments cannot attain exact values unless the thermal properties and viscosity of the flowing fluid are considered. Optical flow instruments introduce no part into the flow. Their operation is not affected by type or properties of fluid. Unfortunately, the cost is as high as tens of millions of yen, and so this type has never been employed outside laboratories. By contrast, when produced in quantity, the new laser flowmeter will be sold at one-hundredth of the price



of the conventional types. It has a wide range of prospective users far beyond research and development institutions.

A cheap LD as used in consumer electronic products will become unstable when emitting light of a single wavelength at less than a certain power level. When falling in such mode hopping, a laser oscillates at a wavelength jumping from one value to another, which may be triggered by such possible factors as changes in the ambient temperature and the optical feedback. Cost-sensitive products including compact-disk (CD) players use a pick-up laser intentionally left oscillating in more than one mode to prevent mode hopping. In accurate measurement activities, however, the multimode oscillation of a laser has been avoided, because the quality of results hinges on interference between the two light beams.

The laser resonance anemometer (LRA), the new flow instrument, uses an LD device emitting a light beam in multimodes. The multimodal light is reflected by a holographic grating, and split into the same number of single-wavelength beams as the modes. The beams go along different angles from the grating, and then through a few lenses to be expanded and then focused. At the focal point, the beams have a cross-sectional pattern quite similar to interference fringes. The LRA is designed to ensure that the split beams are focused at the flow of fluid. When in use, the LRA detects the time period in shimmers of dust moving through the bright and dark zones. Because the module of the bright-and-dark pattern is known, the flow velocity can be calculated easily from the time period. A prototypical LRA is already as small as a palm-top device, and weighs only 1 kg. The LRA may be shrunk to 30 x 30 mm.

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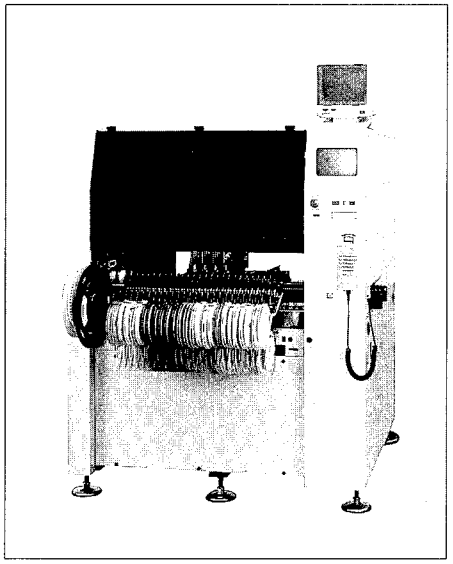
97-07-002-03

System for Mounting Components onto Printed Circuit Wafers

Tenryu Technics Co., Ltd. has marketed a surface mounting machine MT-5530LVII for mounting components rapidly onto printed circuit wafers. It uses a laser beam and a vision system to recognize components, and picks up and positions the components in the positions prescribed beforehand on printed circuit wafers.

Laser recognition is accomplished by irradiating a laser beam on the component from the light emitting unit, the light receiving unit measures the length of the laser beam obstructed by the component to detect the component dimensions, determines the position and attitude of the adsorbed component, then mounts the component in the prescribed position on the printed circuit wafer. Laser recognition enables high-speed mounting of electronic components from 0.5 mm^2 chips (1 mm x 0.5 mm size resistors and capacitors) to 20 mm^2 chips.

Vision recognition enables components lifted with nozzles to be shifted up to a stationary camera, where the position and size of the component are measured and acquired. The component position is automatically adjusted, then placed onto a programmed location on the print circuit board. A single or multiple-field-of-view vision alignment is performed, covering



MT 5530 LVII

with high placement accuracy from 3mm² components up to 54mm² QFPs with 0.5mm lead pitch, 34mm² QFPs with 0.3mm lead pitch, BGAs, and connectors.

Installing a newly developed tray feeder MX-40 (40 platforms, 80 matrices) makes it possible to handle a total of maximum 139 inputs including 59 inputs with 8mm tape feeders. The MT-5530LVII is sold at a domestic price of ¥9,800,000 and the company anticipates to sell 100 units in the first year.

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97-07-002-04

High-Sensitivity Liquid Photoresists for Direct Engraving of Printed Circuit Boards

Kansai Paint Co., Ltd. has marketed a newly developed high-sensitivity liquid photoresists for use in the LDI Process (direct-printing circuit engraving process), a new technique for producing printed circuit boards. The LDI Process enables circuits to be printed directly on photoresists from a computer. The new photoresists features much greater sensitivity than conventional counterparts and enables mass production of printed circuit boards rapidly.

Up till now, there had been no LDI photoresist for the mass production of printed circuit boards, and the LDI technique had been limited to the fabrication of experimental boards or special types of printed circuit boards. The new photoresists have been confirmed to feature a remarkable sensitivity of 0.5 mJ (milli-joule)/cm², and enable mass production of printed circuit boards rapidly. The product has been named Sonne LDI and features a sensitivity of 0.5 mJ/cm², five times that of existing LDI resists.

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97-07-002-05

Piezoelectric Ceramics with Energy Conversion Efficiency of 80.8%

Fujitsu, Ltd. has developed a piezoelectric ceramics that features world's highest efficiency for converting electrical energy into mechanical energy.

Due to its function of converting electrical energy into mechanical energy, (a strain is generated when a voltage is impressed), the piezoelectric ceramics is being used to produce ceramic filters and buzzers for various types of office automation equipment and home electrical appliances. As a material with a high energy conversion efficiency index of k_{33}, even a single crystal with a conversion efficiency of over 92% has been reported. However, the manufacturing cost is extremely high and the shape limited, so commercialization had been delayed up till now.

By contrast, the polycrystal ceramics produced by sintering can be manufactured at a low cost and can be fabricated into various shapes, so it has a broad scope of applications, but its maximum energy conversion efficiency k_{33} is limited to 78% at the highest. In addition, these piezoelectric ceramics consist of compounds containing expensive elements such as scandium (Sc), their sintering temperatures very high (over 1,200 °C), and expensive platinum (Pt) has to be used as the electrode material, so they have also failed to undergo commercialization.

In these respects, the newly developed piezoelectric ceramics is a lead-based perovskite compound consisting of lead nickel niobate, lead titanate and lead zirconate($Pb(Ni_{1/3}Nb_{2/3})O_3$,$PbTiO_3$, $PbZrO_3$). These piezoelectric ceramics have been under research from the first half of the 1970s, but there was no notable improvement after that. The Fujitsu Research Laboratory directed its attention to this series of piezoelectric ceramics having a comparatively high k_{33} index and conducted research to elucidate the material's characteristics.

Improved mixing and crushing processes were introduced to suppress the mixtures of small quantities of impurities, and depth studies were advanced to clarify the influences of ultrafine structural changes on the piezoelectric characteristics. As a result, a structure of excellent characteristics unknown up till now was discovered, and by using ceramic powders of uniform particle sizes and studying the subtle changes occurring in the structure in the synthesis process, this new piezoelectric ceramics material was developed that can be sintered at a low temperature of below 1,000 °C.

The new piezoelectric ceramic features an energy conversion efficiency with a k_{33} index of over 80%, so a big displacement can be obtained with a low voltage. Also, since it can be sintered at a low temperature, electrodes made of inexpensive silver-palladium (Ag-Pd) can be used. The material is ideal for use in the fabrication of high-efficiency laminated type piezoelectric devices.

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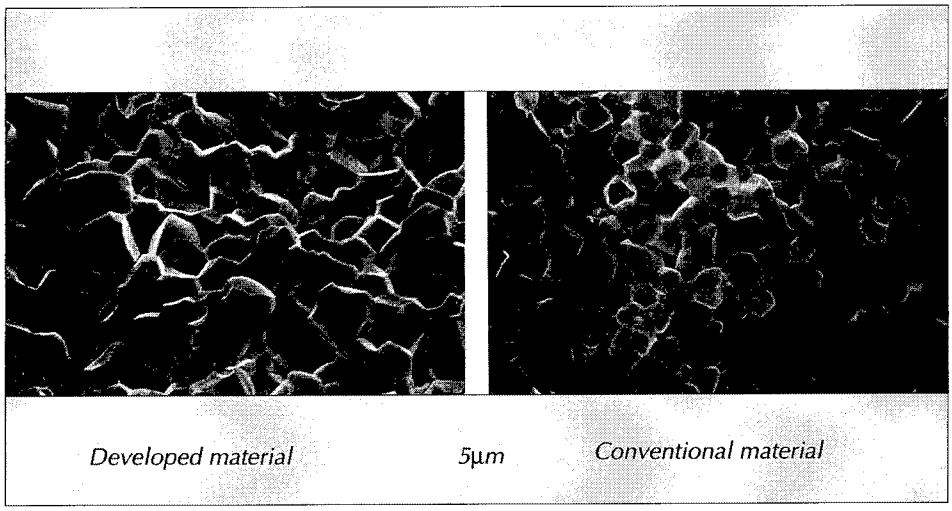

Machinery & Mechatronics

97-07-003-01
Depalletizing Robot Using Random-Dot Projection Stereo System

Mitsubishi Electric Corp. has built a prototype robot that automates the work of depalletizing. A diffuse light beam is directed against the cargo from directly above and the cargo is discriminated in three dimensions with a camera. The cargo loaded onto a pallet is transferred automatically onto a conveyor system with the robot arm. The system can work with cargo in bags or containers which have broken during transportation.

The new depalletizing system consists of the arm type robot, an image processing personal computer, a projector positioned right above the cargo, and two units of charge-coupled device (CCD) cameras. The two-dimensional and three-dimensional target recognition techniques are combined for cargo recognition.

Firstly, a diffuse monochrome light beam called a random-dot pattern beam is directed on the cargo with the projector, and the three-dimensional image of the cargo is captured with the two cameras to assess general information such as which cargo lies in the uppermost position. Next, pattern matching is performed with one camera for two-dimensional recognition and to assess the cargo position accurately. The cargo is then grasped by the robot arm. The position of the cargo is assessed in as little as about three seconds. The system is usable for working with broken cargo or cargo with complicated surface patterns. The device used in the robot system recognition unit is simple and available at low cost.

Labor conservation is demanded in cargo loading and unloading systems, and robots have already been commercialized to automatically transfer cargoes from conveyor systems onto pallets. However, the commercialization of a robot system working in the opposite direction, or to transfer cargoes from pallets onto conveyor systems, is delayed due to the difficulty in assessing the positions of the cargoes accurately. In particular, there is no system to handle bagged cargoes.

Cargo recognition was previously performed by the three-dimensional recognition technique, or by detecting the time delay of a reflected laser beam, but these systems are complicated and difficult to fabricate in compact sizes, and were incapable of high-speed cargo handling or working with colorless cargoes.

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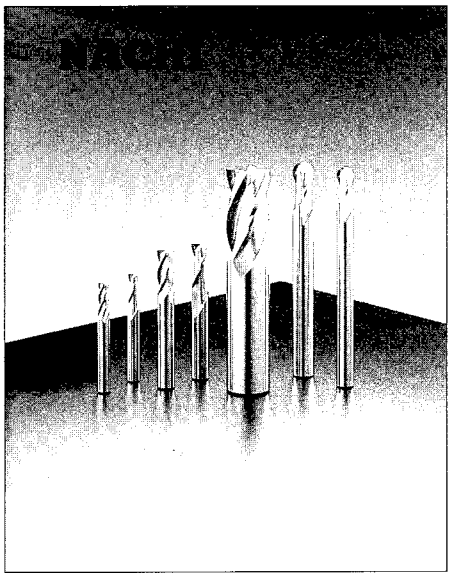
97-07-003-02
Non-Treated Cemented Carbide End Mills

Nachi-Fujikoshi Corp. has commercialized a series of non-treated cemented carbide end mills Anchor V End Mills which are available in three types (two flute, four flute and ball nose), and feature tool life which is 20% longer than other similar products.

A unique design was devised by quality engineering method as well as Nachi's long experience. Therefore, the cutting performance has been improved considerably and excellent surfaces can be obtained. An ultrafine grain carbide alloy is used that features excellent chipping resistance, so that the tool life has been doubled compared with similar products.

The selling prices of these non-treated cemented carbide end mills are about four times those of high-speed steel end mills and about 60-70% those of PVD coated carbide end mills. The market trend is shifting from high-speed steel to carbide. It is increasing the market share of non-treated carbide end mills of reasonable prices for use in the manufacture of various products in small lots. Demand is also being increased due to the need for good finishes of cut materials and high efficiency. The company plans to sell these end mills actively for use in the manufacture of precision machine parts as well as various types of dies made of alloy steel, carbon steel, stainless steel and heat-resisting steel.



Anchor V

The domestic selling price of a two flute is ¥3,620-38,400, that of a four flute ¥5,170-42,800, and that of a ball nose ¥5,440-62,700. The company anticipates a sales revenue of ¥200 million in the initial fiscal year.

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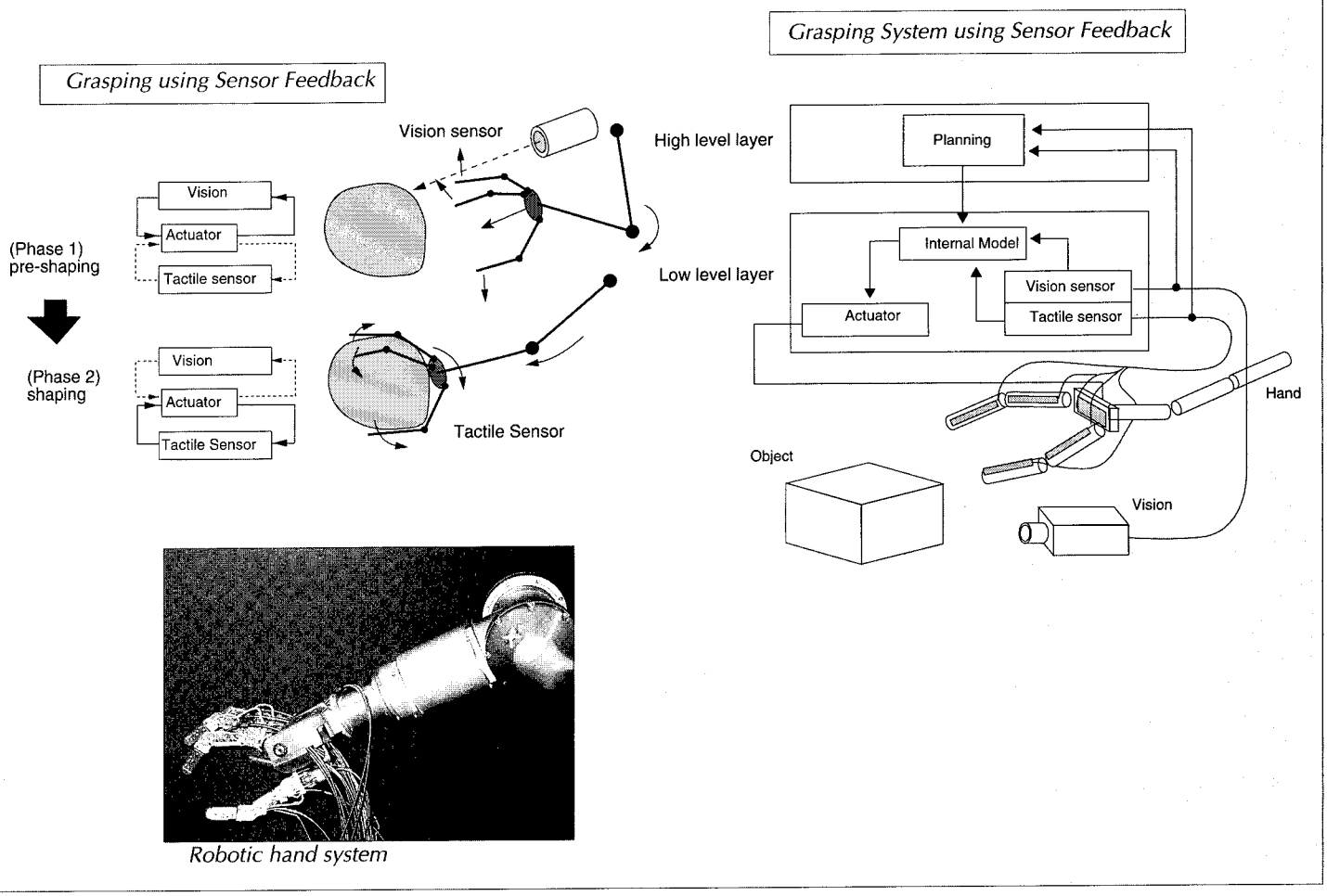
97-07-003-03
Robotic Hand System with Combined Visual and Tactile Feedback Loops

Prof. M. Ishikawa and a research team at the University of Tokyo have developed a robotic hand system which can promptly pick up and hold an object of any shape. To achieve such dexterity, the system has a combined feedback architecture in which a visual sensor (a CCD camera) subsystem cooperates with a tactile sensor subsystem.

Most conventional robots working have no external sensor such as a vision or tactile sensor to govern movement. Work robots, other than a few autonomic ones using their own sensors, are nothing but machines performing programmed functions. These robots cannot carry out other tasks



Robotic hand system

including such simple operations as picking up a piece of article when the object is off a predetermined point or even faces irregularly.

The new system consists of a television camera, a controller computer, and a commercially available arm robot having a custom-built four-finger hand. The fingers are furnished with force sensing devices, which is used instead of tactile sensors. The output signal of the camera is processed to enable the robot to orient its palm and fingers to the best positions before grasping a target object. The hand thus opens just enough to catch the object, and then surely and quickly grasps the object. If the hand holds the object awkwardly, the tactile feedback feature allows the system to change the grip again and again until the object is held optimally.

The central rules the computer uses to govern the system operation are represented by evaluation functions. Before holding an object, the robot begins by collecting data on the shape of an object using the visual sensor. The computer relies on the data to calculate how much to bend and open the hand and how much to stretch the fingers, then effects the hand and finger positioning, as the human brain orders the muscles to open the hand as wide as the size of a cup or something before taking it. After the object is caught, the evaluation functions are again used to adjust the possibly awkward grip of the robot hand. Source data, now obtained by tactile sensing, are processed by the computer to seek the best holding positions of the fingers under the guidance of the evaluation functions. These two operations are achieved by using the same evaluation functions and planning algorithm, and as a result total motion is smoothly executed. The evaluation functions have a few variables concerned with the robot and the object, and these widely change with weights imposed on those parameters. Because the functions cover many features for grasping, the system has a very extensive range of applications from actively hammering down a workpiece to passively supporting a heavy load.

The technology which takes advantage of data from several sensors is called "sensor fusion". This is used to build up reliability of sensor information or to make up locks of information. Sensor fusion technology is now included in much robotic research, but no robotic grasping system so far has used visual and tactile sensor feedback.

The new system can manage its components feedback rate of 1ms except vision, which is rather slow because of picture frames. The current goal is to increase the overall processing rate of the system.

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97-07-003-04

Two-Way Bending CNC Pipe Bender

Keiyo Bend Co., Ltd. has started marketing a double head CNC pipe bender MAC-D170PM-VL that has a greatly improved control system compared with those of its conventional counterparts.

The company used to use original parts which developed by themselves, but redesigned the machine to combine use of parts available on the market as well as those manufactured under consignment, and succeeded in lowering the pipe bender price by about 10% compared with before, while improving the efficiency by about 30% without deteriorating the working accuracy by introducing innovative control systems and improving the functions of drive unit parts.

Overall control uses a program logic controller marketed by Omron Corp, and the hydraulic control for the main drive system uses a controller developed under consignment by Yuken Kogyo Co., Ltd. The Omron controller allows the user to perform maintenance work easily, and uses parts procured from foreign markets. In addition, the control panel incorporates a display system that improves the bender operability, and eases the work of altering the bending data as well as the machine working program, which had been difficult for the user to perform.

The new pipe bender is a high-speed machine capable of working with double bending process, and is therefore ideal for processing long pipes for producing steel furniture and seat frames. The bending unit has less contingent deformation, uses a lightweight, sturdy bending gear box, and is capable of rotating up to 180 degrees for bending in skew.

The bender is (L)3,500 × (W)1,300 × (H)1,900 mm and weighs about 2 t. It is available in three models usable for bending various types of metal pipes with diameters of 25.4, 38.1 and 42.7 mm, and is marketed at domestic prices of ¥21 - 23 million. The company anticipates to sell 20 units of the pipe bender annually.

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97-07-003-05

Explosion-Proof Mobile Inspection Robot

Mitsubishi Electric Corp. has developed a mobile inspection robot that can move about in an explosive atmosphere. The mobility unit has been lightened to 27 kg, about one-tenth compared with before, and the explosion protective design is adopted to enable the robot to engage in operations in an explosive gas environment. It is ideal for introduction into the existing fuel storage facilities of power plants.

The robot is 80 cm long, 25 cm wide, 50 cm tall, and its weight is about one-sixth compared with those of existing robots. It can be used to monitor heavy oil fuel storage tanks as well as ancillary pumps, pipings as well as boilers which may contain gases. The motor and other equipment liable to cause gas explosion are accommodated inside pressure-resistant containers, and the motor, camera and other equipment are assembled inside four separate containers instead of into a single container. The power unit is not accommodated inside the robot, as the necessary power is supplied through an external cable. The four containers are cylindrical, made of aluminum alloy, and used for accommodating the motor for moving the robot on rails, a camera moving robot, a charge-coupled device (CCD) camera and ancillary terminals. The travel distance is about 50 m, and remote robot manipulation and monitoring are possible with a communications cable.

Most existing systems for monitoring the fuel storage facilities of power plants consist of stationary cameras with explosion-proof specifications, and while robots for mobile monitoring are in use, these systems are massive and therefore are difficult to install in existing plants due to lack of space. The new robot can be introduced into existing power plants of limited space, and since it is lightweight, the rails can be installed at low cost without requiring rigid weight-withstanding specifications. Even if a gas explosion occurred inadvertently inside the robot, there is no hazard of any external explosion as long as the explosion force is within 10 atmospheres.

The new robot is effective for improving the efficiencies, labor conservation and safety improvement of maintenance and inspection operations, and plans to promote the robot for use in thermal power plants and chemical plants.

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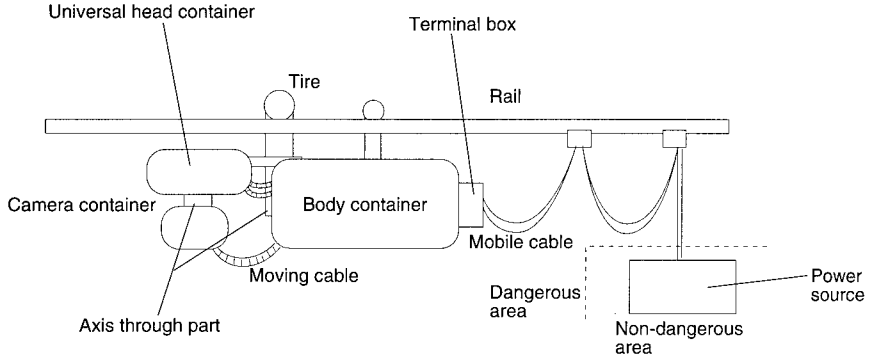

Explosion-proof inspection robot structure

Information & Communications

97-07-004-01

Multichannel High-speed Radio Technology Using a 2.4 GHz Band

Kokusai Denshin Denwa Co., Ltd. (KDD), Japan's international telecommunications carrier, has developed a multichannel high-speed radio technology that allows a wireless local area network (LAN) system using a 2.4 GHz band to transmit data at up to 18 Mbps. This is the world's fastest throughput for a wireless LAN system.

Wireless LAN systems can be easily set up and altered as they require no indoor wiring. However, their transmission rate is low, normally one 2 Mbps channel, compared with wire LAN systems, which attain equivalent to 10 Mbps. Consequently, only a single terminal could use a wireless LAN system at one time.

Carrier Frequency Offset-Spread Spectrum Multiple Access (CFO-SSMA) multiplexing technology developed by KDD ensures that multiple 2 Mbps radio channels do not interfere with each other. A further technological development, demand assignment, allows more than one user to use the system simultaneously. These two advances make possible a wireless LAN system that multiplexes up to nine 2 Mbps channels, a total of 18 Mbps, in throughput. It is possible to set up a wireless LAN system that is as fast as a wired LAN system and realize high-speed data and video transfer within the LAN.

KDD has developed a multichannel high-speed wireless system prototype that transmits four 2 Mbps channels simultaneously. By adding Ethernet-compatible interfaces to this system, radio links could enable 20 to 30 terminals to be connected to single LAN or individual LANs linked by radio. The new system eliminates the need for rerouting cables when changing network layout and allows notebook-sized PCs to be used anywhere on a premise. This represents far greater economy and convenience than conventional wired systems.

After refining the multichannel high-speed wireless LAN and point-to-point wireless systems, KDD will market them through KDD Technology Corporation and other subsidiaries within this fiscal year. The systems should find a range of applications, such as premise portable terminal information systems, inter-building communications and local monitoring systems using video cameras. KDD also anticipates that the technologies will find application as subscriber radio systems for telecommunications services in the future.

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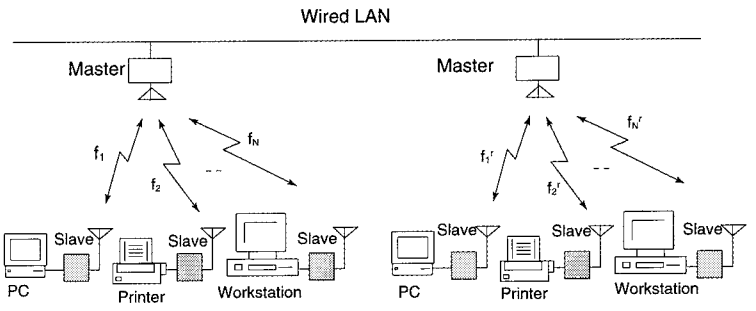
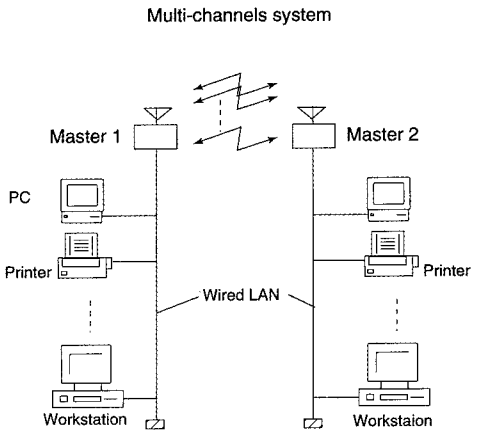
Examples of System Configuration



Wireless LAN using master-slave architecture

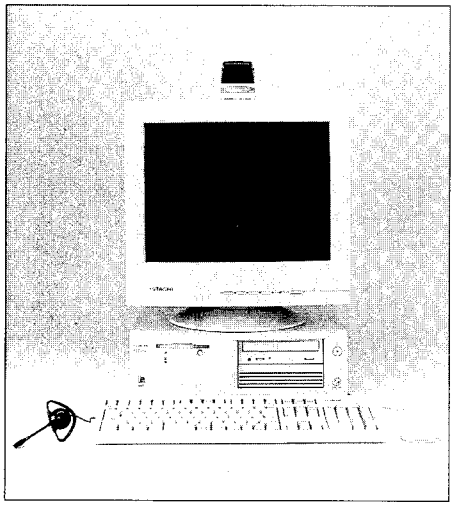


Wireless LAN using master-master architecture

97-07-004-02
TV Conference System for Five Places Simultaneously

Hitachi, Ltd. has commercialized and started marketing a TV conference system Viewwork PV-400 with a personal computer incorporating a TV conference function which enables TV conferences as well as applied joint operations to be held simultaneously at a maximum of five places

The incorporation of the conference holding function enables conferences to be held at a maximum of five places simultaneously without having to install an external multipoint TV conference control system. The multipoint linkage system adopts the ring type connection system, so the system running cost (basic service charge, communications cost) is less than when using a star type linkage system. In addition, the sound from the other participating points are heard in a mix, so the voices of more than two places can all be heard. The images of the four other points are monitored simultaneously and displayed in four quartered sections on the display, so all participating points can be seen at once, and the sectional display can also be switched over to a single display.



Viewwork PV-400

Texts and tables can be prepared and corrected by bothway manipulation with the application software, while colored characters can be inscribed on the photographs and diagrams shown on the screen. Further, files on the personal computer hard disk or floppy disk can be transmitted to other parties while the TV conference is in progress to enable conferences to be advanced while exchanging necessary data rapidly.

The system incorporates a high-definition still picture transmission function that enables still pictures to be transmitted with a clarity of about four times compared with the transmission of animated pictures. The system also conforms to international standards (ITU: T H 320), so audio and video communications is possible with other TV conference systems conforming to these standards. It is marketed at a domestic price of ¥698,000, and the company anticipates to sell about 1,000 units of the system annually.

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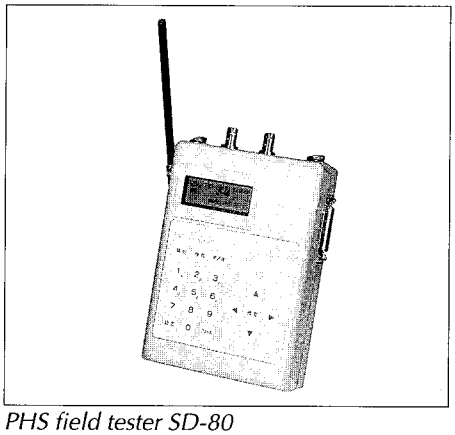
97-07-004-03
PHS Tester for Field Use

IWATSU ELECTRIC CO., LTD. has marketed a PHS Field Tester Model SD-80 that can confirm the personal handy phone system (PHS) service area and make error rate measurements, by which the maintenance of cell stations can now be accomplished with ease.

Model SD-80 is designed compact and lightweight (A5 size and weighing about 800g), and is driven with batteries (four UM3 batteries). It is used to monitor the logical control channels of cell stations and personal stations, and is a field PHS tester enabling the measurements of the field intensities. In addition, it is usable for measuring the error rates, error rates of T-channels, synchronism confirmation function and area detection function, and is usable for the integrated evaluation of the time correlation by connecting it to a personal computer. Further, it is usable not only for measuring the field intensity, but by connecting a computer, has a measurement mode for displaying data received from cell stations and personal stations in real time.



PHS field tester SD-80

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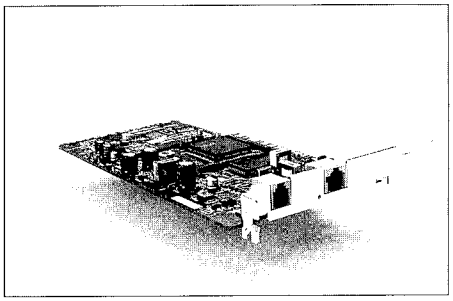
97-07-004-04
ISDN Terminal Adapter Board Compatible with 128-kbps Communications

NEC Corp. has commercialized and marketed a terminal adapter (TA) board AtermIB55Pro that utilizes the integrated services digital network (ISDN) circuit and which is optimized for connection to the Internet. By simultaneously using the two B-channels of the ISDN circuit, high-speed communications of 128 kbps is realized. It is also possible to optionally switch access to 128 kbps or to 64 kbps.

The ISDN board features an asynchronous communications mode of 57.6 kbit/s, the maximum speed for an ISDN board, uses two channels and can achieve simultaneous access to the Internet system and personal computer communications. If the access point is busy, an automatic dialer that automatically provides linkage to a separate connection point is provided. An analog board enables communications with a modem, a telephone unit or a facsimile system while maintaining data communications with the ISDN circuit.

The adapter board is marketed at a domestic price of ¥24,800, and the company anticipates to sell 30,000 units of the adapter board annually. The company has also started a sales campaign to sell the IB55Pro ISDN set that includes the adapter board and a TA (IT45DSU) incorporating a digital circuit terminal system (DSU). The domestic selling price for the unit is ¥59,800, and the company anticipates to sell 5,000 units annually.



AtermIB55Pro

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97-07-004-05 Intelligent Distribution Control System

Fluke Co., Ltd. has developed an intelligent distribution control system NEUCOM that, simply by connecting, enables the establishment of a large-scale control system without requiring a host computer. A unique protocol (communications procedure) is introduced that enables integrated control of intelligent buildings, factory automation (FA) systems and home automation (HA) systems, and a single system can perform a maximum of 128 × 128 controls.

NEUCOM is a new type of control terminal featuring a unit for establishing an independent distributed control of system previously accomplished with PLCs and a communications function. It is based on an entirely different concept compared with the conventional remote I/O concept.

The system has been made compact and lightweight through the introduction of the most advanced LSI technology, features ease of introduction into machines and control panels, and is designed for the most efficient use of space. It is applicable to all types of systems from small to large simply by increasing its number. Introduction of the ladder chart system enables anyone to perform programming and debugging with ease, and the linkage part can be manipulated and read out in the same manner as internal variables and therefore requires no new programming of the communications unit.

At the design stage, the system functional block can be fabricated in modular form to enable reutilization and additional alterations to be performed with ease. Therefore, it can be commercialized independently as a functional block for use in industrial plants and, by using in linkage, it is possible to establish plant systems with ease while suppressing additional capital investments.

The system is usable as an efficient and low-cost system for the distributed and/or integrated control of building air conditioning, illumination, disaster prevention and crime prevention systems, also for controlling plant facilities, machinery, production lines as well as for energy control.

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97-07-004-06 Radio Modem Working on Low Transmission Power

Datalink Co., Ltd. has developed a radio modem DSSNET-R operating on low power with the fastest communications speed of maximum 153.6 kbps in Japan, sixteen times faster than the fastest speed previously of 9,600 bps. This development now enables fast radio communication in factory automation (FA) and office automation (OA) systems.

Speedup was achieved by introducing a direct spread spectrum system of 2.4 GHz as the transmission system. The communication range is 50-100 m indoors and about 800 m outdoors. The use of the HDLC (independent synchronization) procedure as the communications procedure for intermodem radio transmission enables error-free transmission without data loss or quality deterioration.

The radio unit operates with a low transmission power of 10 mW/MHz. It has a compact size of (L)40 × (W)124) × (H)75 mm. It has acquired a technical standards compatibility certificate, so no additional radio operating permit is necessary for its use. It is usable in three radio transmission modes, the point-to-point mode, multiple unit mode, and repeater roaming (tracking of mobile modem) mode, which can be set optionally. The modem is sold at a domestic price of ¥126,000.

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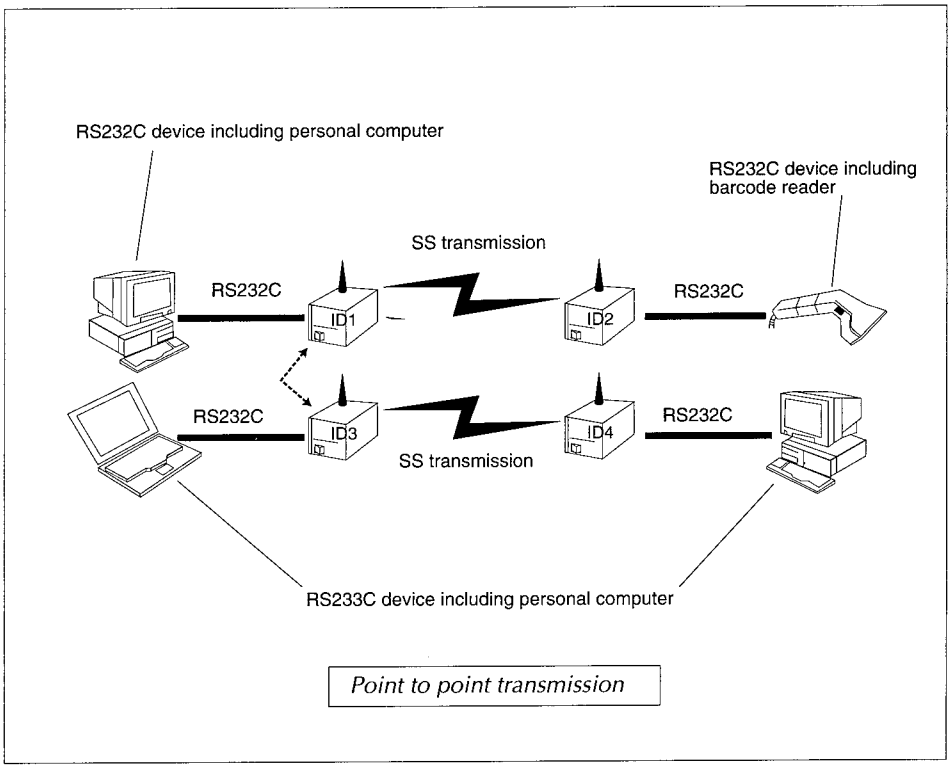

Point to point transmission

97-07-004-07

Multimedia Narrow-Bandwidth Mobile Radio System Based on RZ SSB Modulation

NTT Corp., with the cooperation of NTT Electronics Technology Co., Ltd., has developed an RZ (Return-to-Zero) Single Sideband (SSB) Narrow-Bandwidth Mobile Radio System enabling quality transmission of voice, fax, still images and data even when a vehicle moves about at high speed.

This new mobile radio system enables multimedia communications with a narrow bandwidth. The transmitter adopts the SSB modulation system to minimize the frequency used, while the receiver adopts the frequency modulation (FM) system for digital processing. The establishment of this technology narrows the frequency bandwidth used and, in principle, decreases the noise to enable quality transmission, so the system is ideal for multimedia communications.

The frequency band that is used is 5 kHz, so communications are possible with one-fifth of the frequency bandwidth (FM system, 25 kHz) presently used widely for business radio communications. Therefore, a transmission capacity that is five times larger can be obtained with the same frequency bandwidth. In addition, multimedia communications is possible, so voice, music, fax (G3), still images and data can be transmitted.

The system is highly resistant to fading, quality communications is possible in a vehicle moving at a speed of over 100 km/hr at the same level as when transmitting at standstill. Another distinct advantage is that, with the same transmitter output, the RZ SSB system has a communications distance of about 1.5 times compared with the conventional radio system (FM system, 15 kHz) that is used widely for business purposes.

Business radio communications by taxis, trucks, police and administrative organizations and agencies demand radio wave reception at high speeds, and must withstand the intense fluctuations in received radio waves during transit. Up till now, to retain quality mobile business radio communications, the FM modulation system demanding a wide frequency band was used. However, the radio frequency bandwidth (60-250 MHz band) alloted to business radio communications has become inadequate recently due to the increased number of users. To cope with the situation, research was advanced which led to the development of the mobile business radio communications system that draws on the merits of the amplitude modulation system requiring a narrower frequency bandwidth and enables multimedia transmission of voice, fax (G3), still images and data signals.

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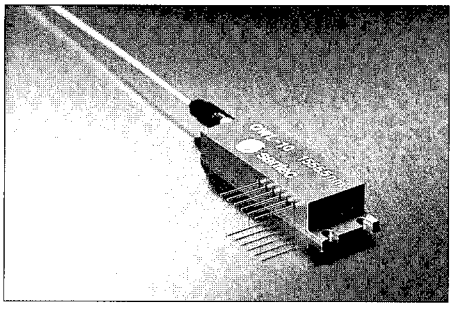
97-07-004-08

World's First Wavelength Locker

Santec Corp. has succeeded in developing the world's first passive desilencing wavelength locker and started distributing samples of the wavelength locker from April this year. This is a key component vital for improving the performances of futuristic high-density wavelength multiplexed optical communications systems.

The new wavelength locker is a superminiature passive desilencer module that resolves the various problems associated with the futuristic high-density wavelength multiplexed optical communications system and is an application of the company's precision optical technologies and a high-performance wavelength-variable optical filter. It has been made compact by decreasing the number of components to less than one-third compared with its existing counterparts, features excellent reliability and is suitable for mass production.

In addition, the optical components feature excellent thermal characteristics and therefore require no temperature regulation. The temperature stability is 0.002 nm/°C and the wavelength setting accuracy is within ±0.02 nm. It has a height of 8 mm and can therefore be mounted on a single printed circuit wafer and achieves long-term reliability by airtight sealing.



OWL-10

The standard settable wavelength is the grid wavelength for high-density wavelength multiplexed optical fiber communications prescribed by the International Telecommunications Union (ITU), but the wavelength locker is also capable of coping with the preferred wavelengths of users. Simply inputting a portion of the optical source enables the disparity with the standard wavelength to be output accurately as an electric signal, so users can lock the prescribed wavelength simply by feeding back the electrically processed control signal to the optical source drive circuit.

Due to the widespread use of the internet system and video transmission, demand is being raised for capacity expansion and higher speed transmission in data communications. In this respect, the wavelength multiplexed optical fiber communications system features many advantages such as large transmission capacity, system flexibility and economy, so the global trend is to commercialize this communications system not only as a trunk communications system but as a system for the commercialization of optical network systems.

The bandwidths of optical amplifiers are restricted, so as many wavelenths as possible must be multiplexed in a single optical fiber, which demands wavelengths to be used in dense spacings. Therefore, the usual wavelength spacings of 3.2 nm and 1.6 nm are being narrowed down rapidly to 0.8 nm and even narrower spacings. In concert with the use of wavelengths in dense spacings, it will be necessary to control the optical source wavelength on the transmitting side rigidly in order to maintain a high quality level at each wavelength, so the development of a wavelength stabilizer had been needed. The company anticipates to sell about 2,000 units of the wavelength locker in the initial fiscal year.

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Process & Production Engineering

97-07-005-01
Manufacture of Paper Tableware by Molding Process

Shizuoka Prefecture Fuji Industrial Research Institute has investigated a technology with the molding process for small to medium sized papermaking companies. Year by year, household papers, toilet paper, napkins, paper towels, tissue paper etc., were monopolized by large sized companies. The molding process enables these small to medium sized companies to apply the process to diversify their products and to participate in the manufacture of tableware with added high values.

With the molding process, the raw material is poured into the mold, heated while pressing, then dewatered and dried. The paper tableware manufacturing process consists of two paper-making units, the No. 1 papermaking unit for producing paper by sucking in the raw material stored inside a paper chest, and No. 2 papermaking unit for producing paper by feeding a fixed volume of raw material onto a net and making the volume. After producing the paper, heating, pressurizing and dewatering are performed in the dewatering unit, then heating, pressurizing and drying in the drying unit, after which the product is extracted from the takeout unit. In the No. 2 papermaking unit, all operations from papermaking to product takeout are accomplished by automatic operation, whereas in the No. 1 papermaking unit, the wet-web is transferred by hand to the dewatering unit, then operated automatically up to takeout. The production speed is 60-70 s for a paper dish weighing about 10 g (Basis weight conversion of 300-350 g/m^2).

Previously, it had been difficult to adjust the temperature, the processing time and the conditions for mixing chemicals into the raw material in the heating and drying processes in order to give the produced tableware water and oil repellency. The molding process by the Fuji Industrial Research Institute was investigated with a fluoride-based volatile oil agent and an AKD sizing agent. As a result, it appears that both high sizing and proper oil repellency are a well-balanced additional composition.

The production of paper tableware by the molding process is suitable for small to medium papermaking companies because the papermaking speed of molding machines is slower than paper machines and the paper tableware is easy to add high values.

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97-07-005-02
Automated Special-Purpose Machine for Sewing Back Pockets onto Jeans

JUKI Corp. has started selling a fully automated special-purpose machine AVP-875 for sewing back pockets onto jeans and other trousers made of thick fabric. Up till now, sewing machines for shirts made of thin fabrics had been available, but this is the first sewing machine in the trade for working with jeans.

The new machine performs the work previously requiring 2-3 workers in three processes to be accomplished in a single process by one worker and therefore enables substantial labor saving. It is usable for working with materials of medium thickness to 16-oz denims. The machine automates a series of pocket-setting processes, concurrently folding and sewing sequential pocket fabrics in the production line, thereby enables substantial labor saving. A newly developed large-hook, zigzag-stitching lockstitch machine head is used, the machine run at a maximum sewing speed of 4,000 stitches/min, and all sewing operations are executed with split-second response.

A pocket fabric is folded on the worktable and properly tensed with a pocket style jig to create sharp creases without material slippage or bulging. Replacing the pocket style jig, including its adjustment, takes only about five minutes. In addition, the pocket style jig can be attached/removed with ease without requiring any tool. The machine is marketed at a domestic price of ¥10,580,000, which is regarded as being highly economical compared with a three-process production facility.

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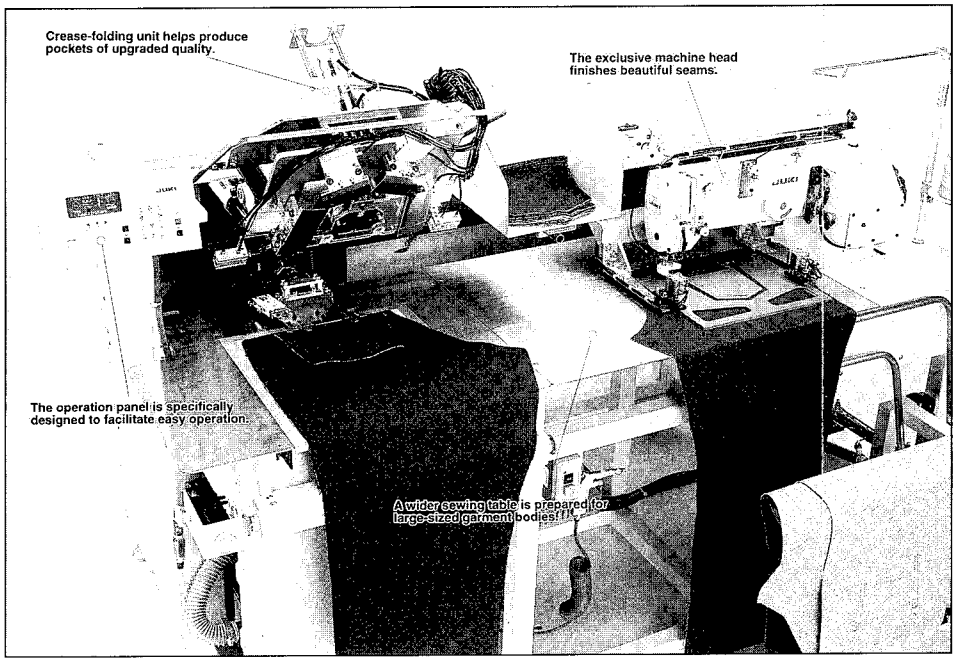

AVP-875

97-07-005-03
Innovative Ethyl Acetate Process

Showa Denko K.K. (SDK) has developed an innovative process for synthesizing ethyl acetate directly from acetic acid and ethylene.

Compared with the conventional process using acetaldehyde as the intermediate, the new process is highly cost efficient as the total cost of plant construction is reduced to about half the previous level. SDK is also constructing a new acetic acid plant in Oita, Japan, based on an innovative process featuring direct oxidation of ethylene.

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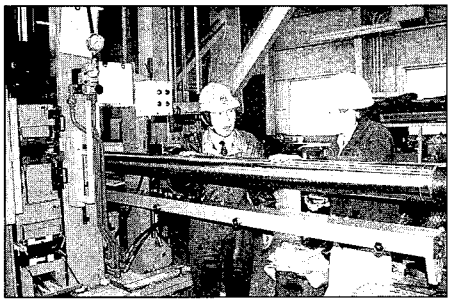
97-07-005-04
Pneumatic Expansion/Contraction Shaft for Separator Guides of Metal Slitter Lines

Japan Development Consultant Inc. has started marketing a pneumatic shaft SealEX for expanding and contracting the separator guides of metal slitter lines. This system introduces a uniquely developed long expansion and contraction lug (movable fixture) equipped with a special seal for use in place of the conventional tube type shaft. The lug enables fitted disks to be adjusted smoothly and to be fixed accurately in any optional position. The shaft is sold at a domestic price of ¥500,000-1,000,000/set depending on its specifications.

The pneumatic shaft is a system used by the paper-making trade to expand and fix into position the paper tube-cores used for winding up paper or films. As a recent trend, the pneumatic shaft is being used increasingly by iron and steel coil centers for setting the separator guides of slitter lines. The conventional type of pneumatic shaft consists of numerous intermittent lugs, so that the disks positioned at the terminal parts of the lugs are shifted out of position or the inside rubber tube is bursting.

The SealEX pneumatic shaft is not of the tube type, so there is no hazard of burst, and since it adopts a long continuous lug system, the system disks can be shifted and adjusted smoothly to enable the disks to be fixed and retained in optional positions very accurately by the long, continuous lug assembly at the time of expansion and fixation. If some abnormality occurred inadvertently with the seal part, the lug part can be drawn out from the shaft for repair or replacement with ease at the worksite by workers due to the simple structure, so as long as a spare long-lug seal is equipped, repairs can be performed without stopping production lines over any long period of time.

There is no unevenness since a self-restoring type elastic seal of special sectional shape and long flexible lugs are used in an assembly, so the attachment and detachment as well as the shifting and adjustment of paper tube cores and disks can be accomplished smoothly. The tubeless mechanism also enables the pneumatic shaft to be designed with great rigidity even when using a long, small-diameter pneumatic shaft, so very smooth revolution is guaranteed without any core vibration caused by flexure, also without any rotary disparity or vibration. Also, there is no need to incorporate an expansion and contraction tube, so the pneumatic shaft can be designed as a thick-walled or solid shaft, and can be made of aluminum alloy.



SealEX

The company plans to incorporate the new pneumatic shaft as an entry guide into the tensioning systems of metal slitter lines, which are one of the company's leading products, and to sell it to paper mills for use in winding up facilities as well as to the printing trade for working with films.

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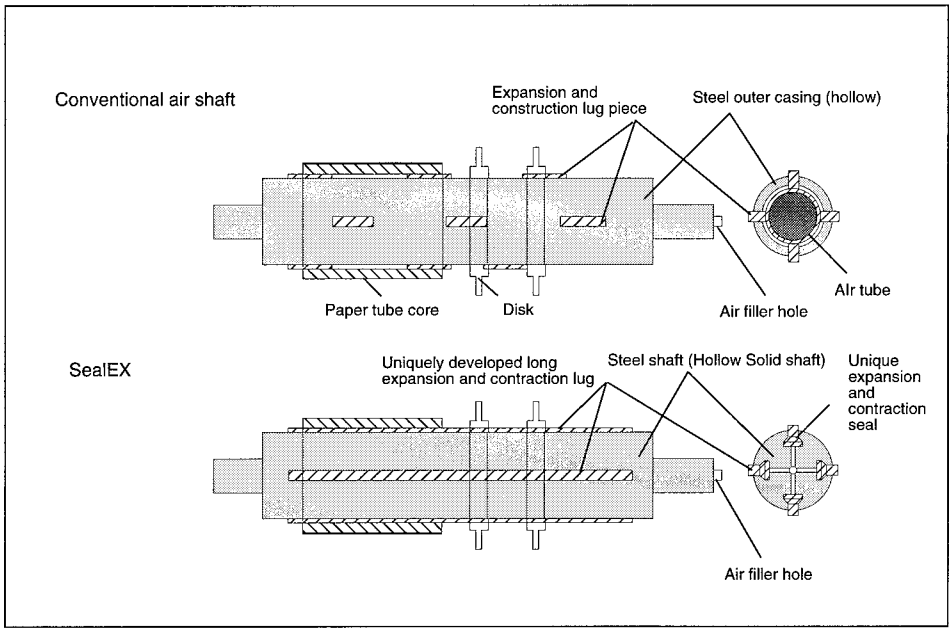


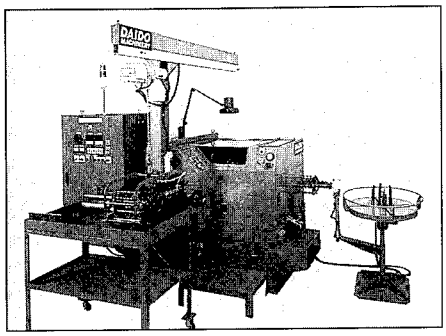
SealEX

97-07-005-05
Parts Former with High Productivity

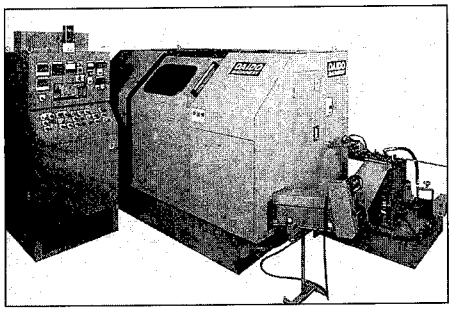
Daido Machinery Ltd., has developed two new parts formers (cold forging parts making machines) featuring rapid preparation and high productivity. Model MF-6PF is for extra-small parts and Model DAP608LX for precision parts.

The Model MF mini-cassette former press-forges extra-small screws with lengths of up to 2.0 mm and diameters of about 0.5 mm as well as electric and electronics parts. It introduces the cassette type preparation changing system. The com-

pression forging mechanism consisting of a punch unit and dice unit is accommodated in the framework of a single cassette to enable preparations to be accomplished for the entire cassette assembly. Complete outside preparations in this manner enables preparations to be completed in less than five minutes as long as outside preparations are performed beforehand. Also, storing a used cassette assembly enables it to be used intact when manufacturing the same parts the next time. In particular, a slide system of excellent ram slide and rigidity is introduced to work with extra-small parts, and the sliding faces are finished by precision scraping.



Model MF-6PF



Model DAP608LX

Model DAP mounts a new wire feeding system fine feed equipped with a gripper for linear reciprocal motions and a fixed gripper simply for closing and opening motions, which are worked in linkage to feed wires very accurately. This mechanism enables wires to be cut without having to use the conventional type of wire stopper, and no damage is generated on the cut ends. In addition, the wires are not bent, and even soft or heated materials can be fed very accurately. Further, compared with a pinch roll, the wire contact area is enlarged, so a stable feed force is obtained without damaging the wire surface.

A new wire cutting system working at high speed is also introduced. A cutter rod with knife is hit by an impact lever to cut wires. This mechanism enables cutting at an initial speed of about 0.5 m/s that displays the effect of high-speed cutting even when the machine is worked at a low speed of 100 rpm. A new mechanism is introduced in which the ram is retained in position by linear-motion bearings those undergo roller motion. Since the ram is impressed with a preliminary pressure, the play becomes theoretically nil, improving product dimensional accuracy conspicuously. Another distinct characteristic is that all punch case holders are maintained as a single unit.

The Model MF parts former is sold at a domestic price of ¥30 million, and Model DAP at a price of ¥50 million.

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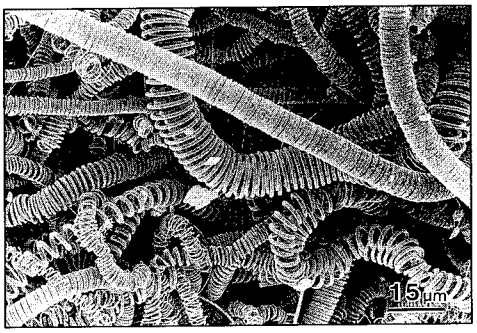
97-07-005-06

Carbon Microcoil and Electromagnetic Shielding Effect

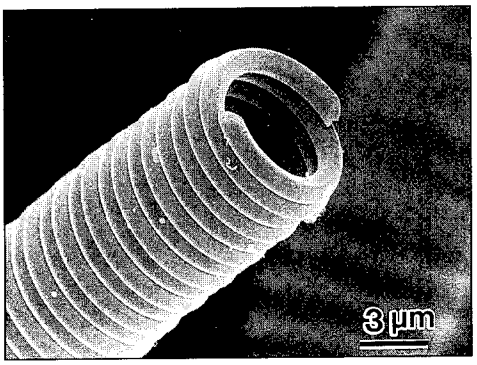
Prof S. Motojima at Gifu University, Prof. H. Iwanaga at Nagasaki University and their colleagues have prepared a "carbon microcoil" fiber material by impurity-activated chemical vapor deposition, and demonstrated that the material absorbs electromagnetic waves emitted by computers, cellular phones and other electronic devices. A case made of plastic material mixed with the coiled carbon fibers prevents most electromagnetic noise from escaping.

Microwaves and other electromagnetic noises are suspected of endangering people's health, and sometimes indeed cause the malfunction of medical or other critical equipment. Electronic products are thus required to prevent electromagnetic waves from leaking, and now use metal shielding. However, this basically does nothing but redirecting back electromagnetic waves, and is not reliable.

The new fiber material consists of, with some exceptions, two coiled filaments in the double helix configuration.



Carbon Microcoil



Carbon Microcoil amplification

Each coil is a few micrometers in diameter, and the length ranges from 0.5 mm to about 1 cm. The fiber is made from acetylene (C_2H_2) gas with the aid of a metallic catalyst and a small quantity of thiophene (C_4H_4S) as impurity. The carbon microcoil material absorbs electromagnetic waves, and turns them into heat. In an electromagnetic shielding performance test, even a small amount of the material absorbed 50-60% of 2.45 GHz waves. In the 12-20 GHz band, the absorption factor is nearly 100%. When made of a plastic material mixed with carbon microcoils, case boxes of PCs prevent electromagnetic noises from escaping. Clothes of carbon-microcoil-mixed fabrics protect the wearer against electromagnetic irradiation.

The new process produces coiled carbon filaments more reliably, but the deposition is too slow, and the process must be improved to be industrially feasible. When in industrial use, the material may be the best remedy for problems caused by electromagnetic noises. The research team is now engaging in developing techniques for that purpose.

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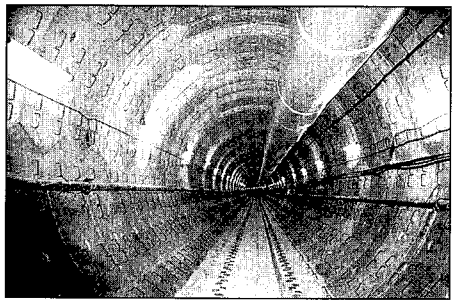
Construction & Transportation

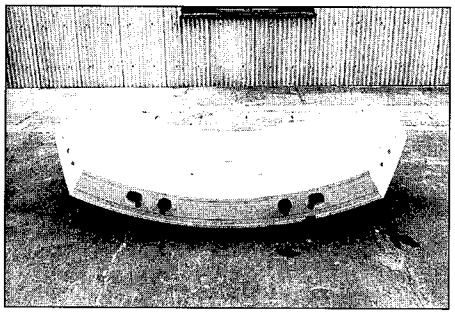
97-07-006-01
"Honey-comb Segment" for Tunnel Lining in Shielded Tunneling

Okumura Corp. and Ishikawajima Kenzai Kogyo Co., Ltd. have jointly developed a "Honey-comb Segment" that is designed to construct tunnel lining subsequent to excavating of shield tunneling. It enables work to be advanced rapidly since it features an enormous strength and can be assembled quickly. Since excavation and segment assembling are advanced simultaneously in shield tunneling, tunneling projects can be completed in short periods of time.

Each Honey-comb Segment has the same size and form. The shape of a segment is close to a regular hexagon that has been stretched in the tunnel circumferential direction and made of reinforced concrete. It is used to construct the lining after excavating a tunnel. Because each joint is formed like a wedge, the stress working on the hypotenuse is distributed into the tunnel circumferential and axial direction in conformance with the shape of the oblique. Due to this characteristic, the segments are more closely linked together with a large load acting on the tunnel periphery.

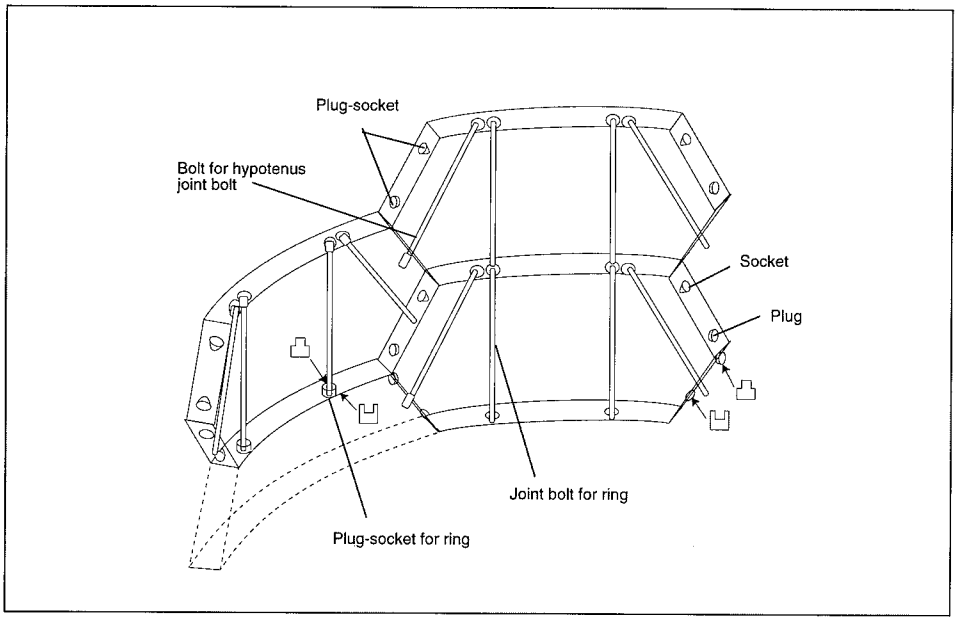


Assembly status of Honey-comb Segment



Honey-comb Segment unit

The joint bolts are inserted from the edge, so this segment is suitable for automatic assembling. Honey-comb Segment requires no bolt box for joints, and since a small number of bolts is used, it is rather economic. Because the inner surface of the lining assembled with Honey-comb Segment is smooth, secondary lining can be eliminated without filling up bolt boxes for preventing rust and corrosion. The joints of this segment have large strength and stiffness, so Honey-comb Segment is applicable to both soft and hard ground. Further, since the guide function of the uneven plug-sockets fitted on the hypotenuses as well as all segments are inserted and assembled in the tunnel axial direction, Honey-comb Segment features excellent assembly and watertight joint.



Configuration concept of Honey-comb Segment

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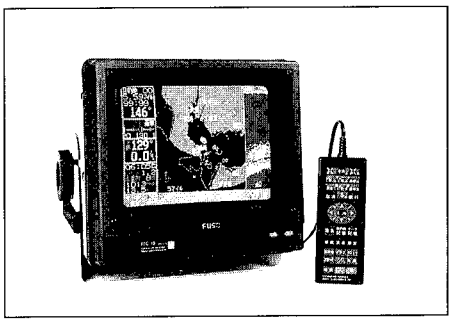
97-07-006-02
Navigation Systems for Cruisers and Fishing Ships

Fuso Electronics, Inc., has developed and started marketing the navigation system FGP-100 for cruisers that contains data relating to several hundred seaports throughout the country, and a navigation system FEG-10 for fishing vessels featuring a fish group detection function.

With both these navigation systems, the ship crew are always aware of the position, waypoints and event marks since these are displayed from instant to instant while the map is being redrawn. The compass sensor is available optionally, which can be connected to see the bow direction even when the ship stops. A built-in barometer displays changes in atmospheric pressure on a graph, and the present position can be displayed in Loran C' s TD in addition to latitude and longtitude. A DGPS receiver can be connected and a cassette is available optionally for insertion to increase the area of display of maps, by which the memory capacity of tracks and waypoints can be increased twofold.

Especially the FEG-10 system with fish group detection function has dual frequency available for fish finder mode. And graph display of depths and temperatures is provided, and able to review the depth and temperature of a past point 30 hours before at maximum.

Both these systems employ a 10-in CRT (400 × 240 pixels) for display, are (B) 309 × (D)350 × (H)283 mm, and weigh 120



FEG-10

FGP-100

kg (including the stand). The FGP-100 system is marketed at a domestic price of ¥450,000, and the FEG-10 system with fish group detection function at a price of ¥550,000.

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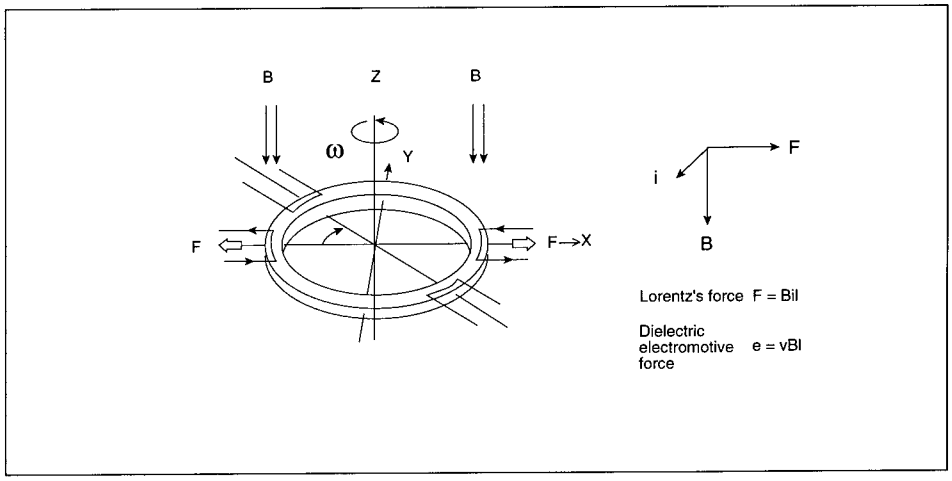
97-07-006-03
Silicon Ring Type Vibratory Gyroscope

Sumitomo Precision Products Co., Ltd. and British Aerospace Systems and Equipment Ltd. (BASE) of the United Kingdom have jointly succeeded in commercializing the world's first vibratory gyro Silicon VSG by applying silicon micromachining technology.

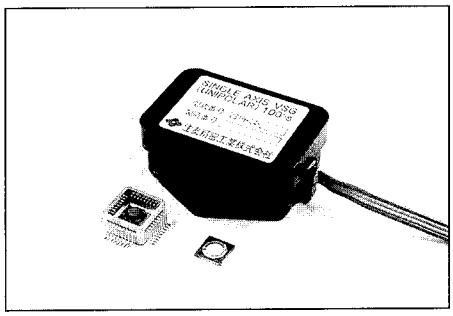
This innovative sensor is usable in car navigation systems, automobile chassis control systems and human motion detection in virtual reality systems. The principle is based on the Coriolis effect generated by the angular velocity w impressed on the Z-axis with respect to the drive vibrations along the X and Y axes of the ring. The angular velocity is derived from the point of generation of the vibrations detected at a position shifted out by 45 degrees from the drive vibrations. The vibration drive is derived from Lorentz's force and is detected using a dielectric electromotive force. The ring resonator is positioned in a magnetic field and driven by an AC current. The vibration caused by the Coriolis force which is proportional to the applied anglar velocity is detected from the dielectric electromotive force generated in the electric circuit actuated in the magnetic field.



Principle of the vibratory gyroscope

The device is made by forming an insulating film on the surface of a silicon wafer, then a wiring A1 pattern, followed by the photoresist pattern, and the ring and its supporting beams are formed by dry etching. The silicon wafer is bonded with anodic bounding technology with a glass wafer serving as the pedestal, then is divided into chips by dicing. The ring resonator is assembled inside a metal package together with the magnetic circuit structural components, then sealed in a decompression chember at 4 torr. The sensor is fabricated by mounting this completed package on a signal processing board together with other electronic components, then accommodating all these parts in a compact case.

The vibratory gyroscope was announced at the SAE Show (a worldwide automotive technology show) held in Detroit, U.S., and samples were distributed to automobile manufacturers and accessory parts manufacturers from March this year. The vibratory gyroscope is applicable to ordinary automobiles as well as industrial vehicles, ships, aircraft, robots, and in the sectors of medical treatment and virtual reality.



Silicon VSG

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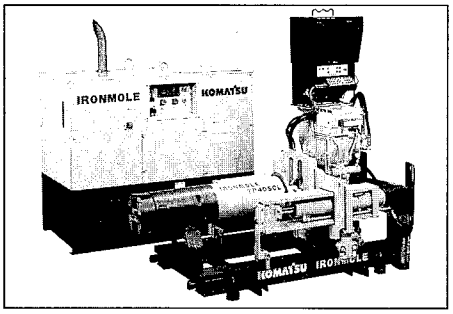
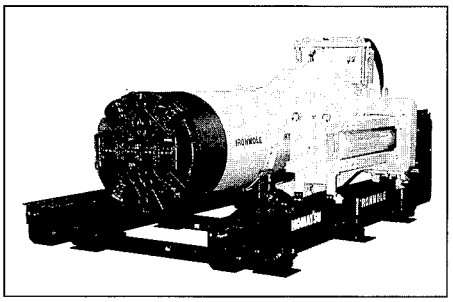
97-07-006-04
Two New Models of Iron Mole Machines for Underground Excavation Projects

Komatsu, Ltd. has added two new models its lineup of "Iron Moles", high-accuracy small-diameter pipe-jacking systems, by which the range of Iron Moles has been increased to seven models.

Iron Mole is installed at the bottom of a vertical shaft and starts joining pipes while digging forward, and enables sewage channels to be constructed without having to dig up roads, so no traffic jams are caused. Demand for the machine is increasing rapidly. The newly developed models consist of the Model TP40SCL (for vinyl chloride pipes) for application to projects using pipes with calibres of 200-300 mm, and the Model TP125S (for hume pipes) ap-



Model TP40SCL



Model TP125S

plied to projects using pipes with calibres of 800-1,000 mm.

Model TP40SCL is designed for use in cities where the worksite area is limited and small shafts have to be dug. It can install 1-m pipes with 1.8-m diameter liner plates. The propulsion system is narrow and mounts the control unit on the body to enable operations inside the shaft to be performed with ease. The screw soil-discharge system is used which requires minimal surface equipment, and an engine-driven hydraulic unit is employed to minimize the area required on the ground and to enable work to be advanced even at small sites. Heads are provided for working with clayey dirt, mudstone and gravel to enable the machine to work with a broad range of soils from ordinary dirt to conglomerate. Also, since dirt compression is accomplished by using large pinch valves and excavation admixture chemicals, facing is accomplished with stability by creating improved soil plug zones to control the excavated dirt volume and for water stoppage, so excavation is accomplished accurately and rapidly even in terrain containing water. The machine is sold at a domestic price of ¥33,600,000.

Model TP125S mounts a curved line engineering real-time measurement system vacuum earth discharge system for the first time on an iron mole machine, which enables tunnel excavation in a curve. It features the largest calibre of an iron mole machine, and can be applied to constructing trunk sewage channels for regional or prefectural government offices. The high-torque cutter head can crush gravel and large stones, and the earth discharge efficiency has been improved by introducing the independent drive system for performing excavation and earth discharge separately. Diverse equipment are mounted such as the independent drive system, facing dirt pressure sensor, large pinch valves, and mechanisms for water stoppage, dirt discharge control, excavation chemical addition and aggregate addition by utilizing the rotary difference between the cutters and screws, so that tunnel excavation is possible over much longer distances than before. The machine is sold at a domestic price of ¥138,650,000.

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Energy & Resources

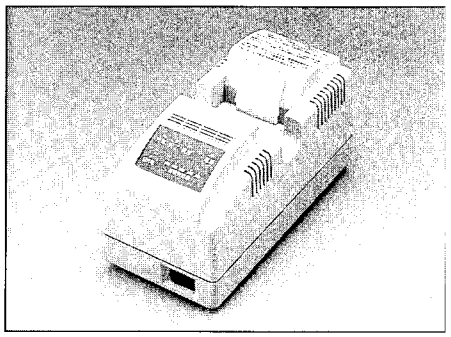
97-07-007-01

Rapid-Charging Battery Charger Usable for Over 2,000 Times

Brother Industries, Ltd. has developed a storage battery charger enabling battery charging rapidly within 25 min and which is usable for over 2,000 recharges. Battery charging is accomplished in about one-tenth the time required by ordinary chargers and the service life is prolonged by about four times, which reduces the disposal of waste storage batteries.

The BE Type Charger is for recharging nickel-cadmium and nickel hydrogen storage batteries. Unique technology allows the extent of recharging of a set battery to be checked constantly to prevent overcharging that is the biggest cause of deterioration of storage batteries. Therefore, using the new charger prevents service life shortening of storage batteries due to frequent charging, especially rapid charging, and various kinds of tests have provided excellent results.

The BE Type Charger features an Automatic Faulty Battery Sorting Function for instantaneously detecting unusable batteries, an Automatic Storage Battery Capacity Deterioration Sorting Function for detecting storage batteries with deteriorated capacities, and a Storage Battery Residual Capacity Display Bar Graph Function for indicating the state of battery performance deterioration during use. The Automatic



Storage battery charger

Memory Effect Elimination Function, compared with conventional types of chargers, allows the new charger to decrease the frequency of occurrence of the memory effect that is caused when additional charging is performed on a battery with residual capacity. Batteries which display the memory effect can gradually recover by repeated charging with the new charger. With conventional types of chargers, the battery capacity is deteriorated if the charged battery is left on the charger due to self-discharge, but the new charger performs charging continuously in conformance with self-discharge and constantly maintains the battery in the fully charged state.

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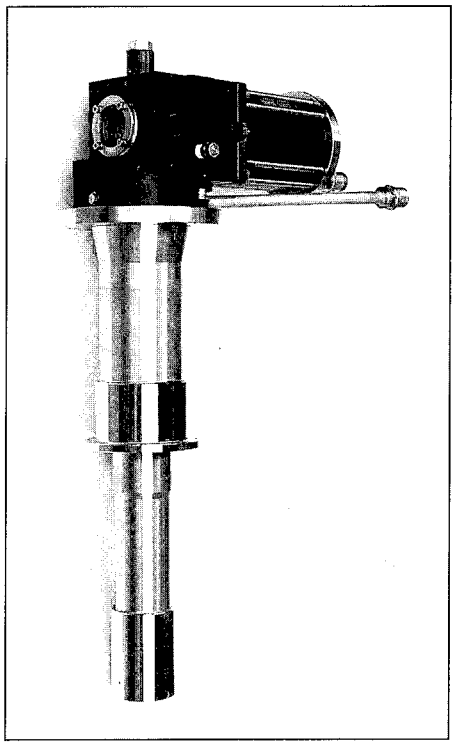
97-07-007-02

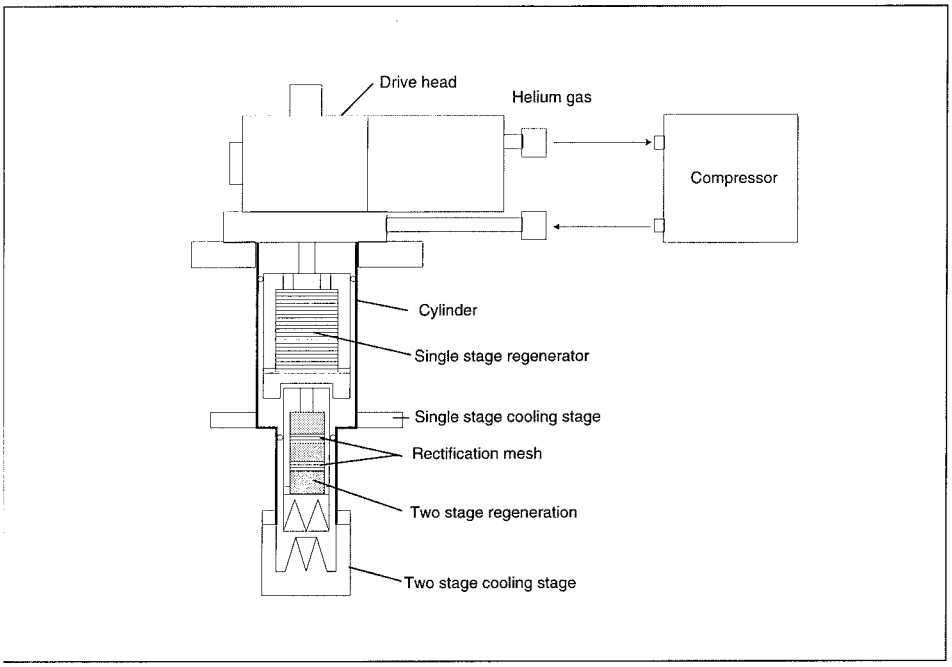
Refrigerator Ideal for Superconducting Magnets

Mitsubishi Electric Corp. has developed a refrigerator featuring an high refrigeration capacity at the temperature of liquefied helium, also applicable to diverse industrial uses and ideal for maintaining superconducting magnets. It is a low-cost system requiring no supplementation whatsoever of liquefied helium and featuring the world's highest refrigeration capacity of 3 W at an absolute temperature of 4.2 degrees which is the boiling point of helium. It is applicable to the manufacture of monocrystal silicon for semiconductors, also can be incorporated in virtually all types of industrial superconducting magnets such as the magnets for synchrotron radiation (SR) systems.

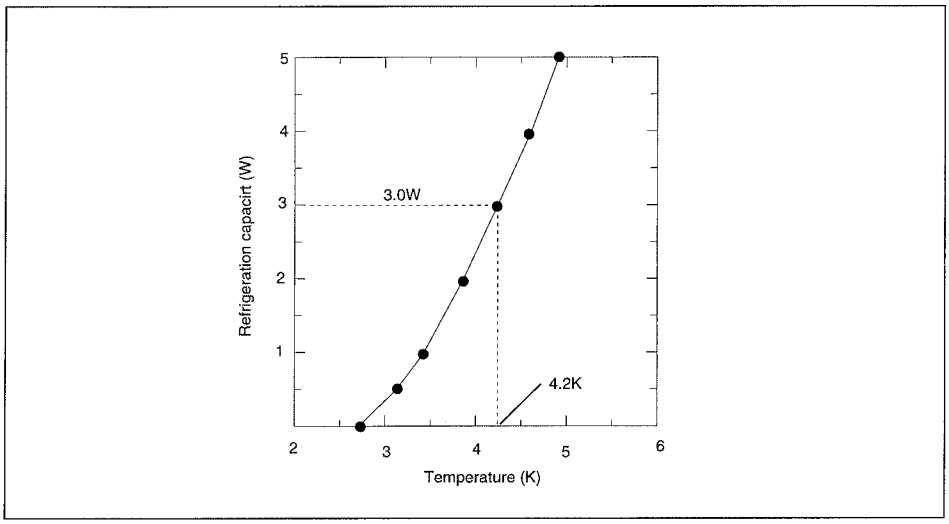
This new refrigerator uses no expensive liquefied helium and is capable of maintaining the temperature of liquefied helium (-269 °C) necessary for the superconductive state and an absolute temperature of 4.2 degrees. The refrigerator operates by the Gifford-McMahon cycle which repeats compression and expansion of helium gas in order to cool to the cryogenic temperature. This time, this GM type refrigerator was improved and it became possible to apply to virtually all types of industrial superconducting magnets such as the magnets for silicon crystal, SR magnets and medical synchrotron magnet. This refrigerator is distinct in that there is no need to supplement liquefied helium to the superconducting magnets.



GM type refrigeration



Construction of GM type refrigerator



GM type refrigeration capacity of refrigerator

The refrigerator was developed by analyzing the mechanism of heat transfer inside the refrigerator with a computer and improving the materials and shapes of the refrigerator's constituent parts. More concretely, whereas stainless steel was being used at the parts for cooling the target objects, which is called a cooling stage, these parts were completely replaced with copper parts while increasing their surface areas. Also to prevent any biased flow of helium gas, a copper mesh was newly installed in the regenerator where the gas passes. By these improvements the exchange efficiency of the cooling stage and the regenerator was improved conspicuously and the cooling capacity increased to 3 W.

The cooling stage was fabricated using pure copper as the material, heat conductance fins were provided, and the heat exchange efficiency between the helium gas and cooling stage was improved by 40% (1.4 times). Also, a mesh was introduced

into the regenerator to prevent biased flow of helium passing through the heat regenerator, by which the regenerator's efficiency was improved by 60% (1.6 times).

Conventional types of GM refrigerator have only a refrigeration capacity of about 1W with those available on the market and of about 2 W with those for use in research, and these refrigerator used to be employed almost entirely for magnetic resonance imaging (MRI) systems or small superconducting magnets, which need less refrigeration capacity. The new refrigerator can be put to diverse industrial applications, and a distinct advantage is to save liquid helium costs of roughly ¥ 37 million/yr compared with systems which require regular supplementation of liquid helium.

Incidentally, the silicon bars for semiconductors are recently being produced in a diameter of 12 in instead of 8 in as in the past, but in order to obtain uniform monocrystals, an intense magnetic field using superconducting magnet is indispensable.

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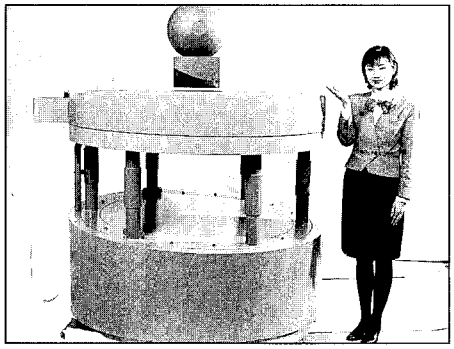
97-07-007-03 Cooler Box for Superconducting Magnets

Toshiba Corp. has developed a cooler box "Cryo-Thermos" for superconducting magnets. Compared with existing vacuum adiabatic (heat insulation) systems for cooling superconducting magnets, the new cooler box is capable of extending the cryogenic temperature retaining time by as much as 10,000 times.

This cooler box simply envelopes the superconducting body in the initial stage with a multiple number of independent copper plate containers cooled to the same temperature to minimize the penetration of heat into the superconducting magnet. Optimization of the material's thickness as well as the multiplexed heat insulation layers maintains the cooler box in a cryogenic state over a long period of time without using any freezer or coolant such as liquefied helium, so even if the cooler box was left in an environment of normal room temperature, much time is required for the temperatures of each and all of the copper plate containers to rise.



Cryo-Thermos

The vacuum heat insulation technique for superconducting magnets in use today is designed to prevent temperature rise of the superconducting magnets by using a liquefied helium cooling medium and/or a cryogenic refrigerator to cool the magnet. This time, this technique was applied and a compact cooler box fabricated experimentally that maintains a high-temperature superconductor at a temperature lower than that of liquefied nitrogen (-196 °C).

The copper plate containers accommodating the high-temperature superconductor are 1 mm thick, and the gap between the respective containers 0.5 mm. Using this cooler box for high-temperature superconductors will enable commercialization research on compact, inexpensive liquefied nitrogen temperature-level high-temperature superconducting magnets and sensors to be continued for several months to one year without having to use liquefied nitrogen or a cryogenic refrigerator.

Cryo-Thermos features a very simple construction. Multi-shell insulation (MSI) are arranged inside a vacuum container without coming into mutual contact and in the form of enclosing the high-temperature superconductor. Cooling these MSIs and the high-temperature superconductor to the liquefied nitrogen temperature and then leaving Cryo-Thermos as it is in the open environment will gradually increase the temperature of the outermost MSI nearest to the vacuum container by action of heat radiation. However, the temperature rise of the other MSIs will be delayed compared with the outermost MSI, and the delay will be the greater, the further inside the cooler box, with the result that the innermost high-temperature superconducting body will be retained at the liquefied nitrogen temperature for a whole day.

The initial cooling temperature of the MSIs can be selected freely between the liquefied nitrogen temperature (77 K) and liquefied helium temperature (absolute temperature 4.2 K), so Cryo-Thermos will be applicable to high-temperature superconducting magnets and sensors used at the liquefied nitrogen temperature as well as to superconducting magnets which are used at the liquefied helium temperature and which have been commercialized for use with futuristic linear motorcar systems and magnetic resonance imaging (MRI) systems.

The cooler box cooled to the level of liquefied helium temperature (-269 °C), when used for cooling superconducting magnets, will require no cryogenic refrigerator, and the superconducting magnet's size can be reduced to about the same size as that of an ordinary conducting magnet.

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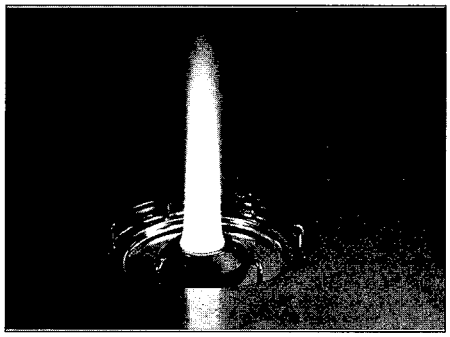
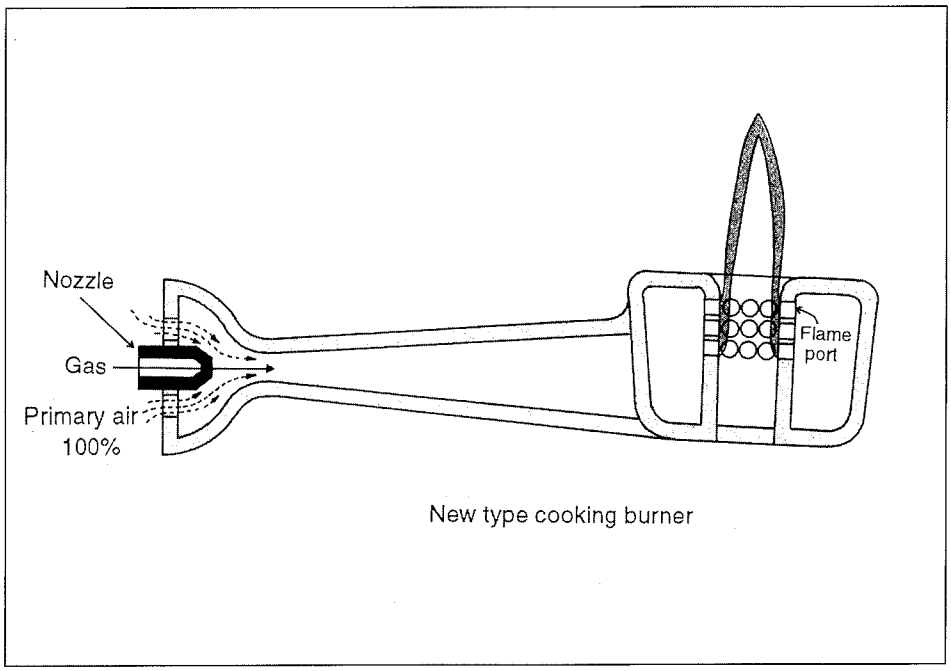
97-07-007-04 Internal-Multiple-Flame-Port Burner Featuring Low NOx Emission and High Heating Efficiency

Toho Gas Co., Ltd., Tokyo Gas Co., Ltd. and Osaka Gas Co., Ltd. have jointly succeeded in elucidating the combustion mechanism of the Internal-Multiple-Flame-Port (I.M.F.P.) burner that features both low NOx emission and high heating efficiency. The companies plan to commercialize the burner by about the summer of this year.

This burner excels over the conventional cooking burner in the aspects of both heating efficiency and non-environmental disruption, so the companies plan to commercialize a burner for commercial use first,



(I.M.F.P.) burner



I.M.F.P. burner

followed with the commercialization for household use. As long as the cost and reliability aspects are cleared successfully, there is a high potential that many of the gas burners in use today may be replaced by the I.M.F.P. burner.

The principle of the I.M.F.P. burner is to supply the premixed gas from the internal multiple flame ports on the surface of an inner combustion chamber. The premixed gas is formed in the mixing tube of the I.M.F.P. burner by the fuel gas and the primary air naturally aspirated from the burner's air orifice. As for the conventional cooking burner that is used widely, the fuel gas is combusted with naturally aspirated primary air and second air supplied from the external regions of the flame of the I.M.F.P. burner. However, the primary air ratio is 70-100%, that of the secondary air 30-0%, or the ratio of the primary air is 10% higher than that of the conventional cooking burner.

The I.M.F.P. burner's flame temperature is roughly 1,500 °C, about 100 °C higher than that of the conventional cooking burner due to its higher primary air ratio. The I.M.F.P. burner requires less secondary air than the conventional cooking burner, so a cooking pot can be placed closer to the burner in comparison with the conventional cooking burner. In addition, the flame spreads outward from the pot's center to enable effective heating of the pot.

With the conventional cooking burner, there is a problem of the NOx production being increased when the combustion is intensified, but with the I.M.F.P. burner, the production of NOx remains on a low level even if the combustion was intensified Furthermore, as an over-all combustion characteristics of the I.M.F.P. burner, the NOx production rate is about one-third, and the heating efficiency is about 20% higher.

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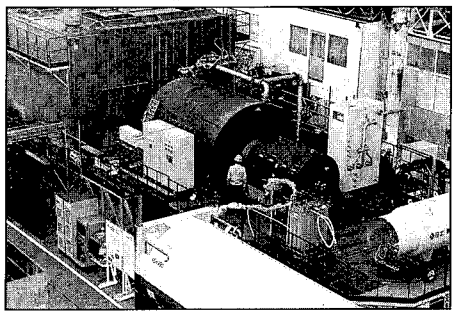
97-07-007-05
Superconducting Generator of 70-MW-Class

Hitachi, Ltd. has developed a superconducting generator of 70-MW-class with a power generation capacity of 83 MVA, the world's largest. Tests at the Hitachi Plant have confirmed that the power generation efficiency is equivalent to 99% that of a 200-MW commercial level generator, but the power generation loss is reduced to two-thirds that of a conventional type of thermal plant generator (air-cooled), the power transmission capacity to electric power system increased by 20-50%, and the weight reduced by about 30% due to the high flux density.

This generator creates a powerful magnetic field of 4 T with a superconducting coil inside the rotor, by which the electricity transmission capacity to electric power system is increased, the voltage fluctuation decreased and the power generation efficiency improved. The rotor used in this generator has a multi-cylindrical construction, stores liquefied helium (-269 °C) at the innermost part and uses a superconducting coil. Also, a vacuum environment is created between the multi-cylinders like a dewar vessel to minimize heat infiltration.

The superconducting generator was developed as a link of the New Sunshine Program of the Agency of Industrial Science and Technology, Ministry of International Trade and Industry, and the electrical tests were consigned by the ministry to the Hitachi Plant. Test running was commenced from April this year at the Super-GM Test Center in the Oska Power Station of the Kansai Electric Power Co., Inc. Osaka Power Station, and load tests will be continued up till August. The superconducting generator, which enables power generation efficiency improvement, transmission of larger amount of power to existing electric power systems and decrease of voltage fluctuation, is under development only in Japan.



Superconducting generator of 70-MW-class

The R&D project was started in 1988, and the schedule is to develop and verify the performance of a 70-MW pilot generator by the end of FY 1998. Starting from FY 1999, a commercial level 200-MW pilot generator will be fabricated to allow commercialization of the generator by the year 2005.

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Environment

97-07-008-01
Chlorofluorocarbon (CFC) Technology Using Existing Industrial Waste

The Ministry of International Trade and Industry is working to commercialize a technology to decompose 99.99% of specific CFCs. The technology has already been established and its performance confirmed through an R&D project implemented to develop CFC decomposition technology utilizing existing industrial waste incineration plants which was consigned to New Energy and Industrial Technology Organization (NEDO) and Kobe Steel, Ltd.

The CFC decomposition technology was established through demonstration tests conducted from mid-February this year with a pilot plant installed at Kobe Steel, and the plan is to continue research in FY 1997 by utilizing the pilot plant with the objective of establishing and commercializing a treatment technology to decompose CFCs with minimal energy consumption and without generating harmful substances. Further, the decomposition technology is to utilize energy most effectively by supplying the heat and hydrogen necessary for CFC decomposition through waste incineration.

The pilot plant is an incinerator based on the rotary kiln system with a capacity to combust 100 kg of industrial waste per hour. The energy obtained through industrial waste combustion will be utilized to decompose the 3-10% CFCs contained in the waste incineration gas, and the system cost is much lower than that of a system based on the plasma decomposition technique.

This R&D project is being advanced as a three-year project starting from FY 1996. The investment cost for the initial fiscal year was about ¥260 million, through which the pilot plant was constructed and demonstration tests were conducted.

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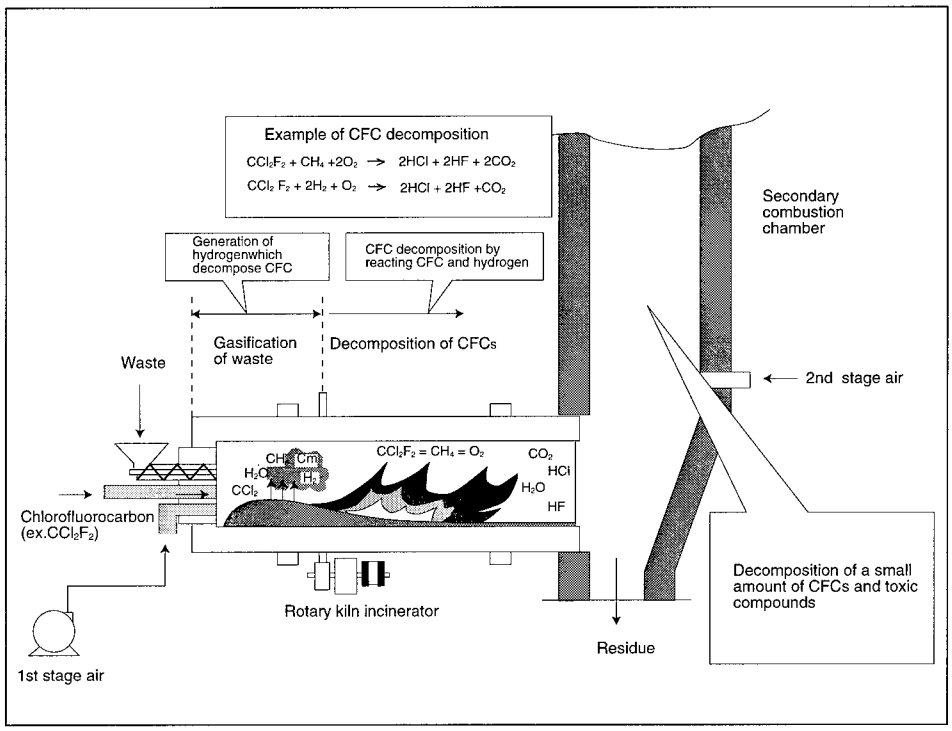


Principle of CFC decomposition by combustion with a rotary kiln incinerator

97-07-008-02
"RDF Clean Combustion Technology" for Small-Scale Combustion Facilities Compatible with New Dioxin Guidelines

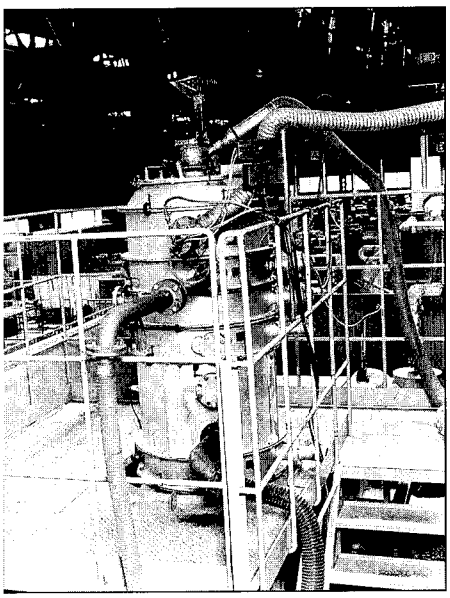
ShinMaywa Industry Co., Ltd. has established an "RDF (Refuse Derived Fuel) Clean Technology" for small-scale combustion facilities that is compatible with the country's new dioxin guidelines, and has announced it will market a combustion facility applying this new technology starting from July 1.

The RDF is pulverized into fine particles, preheated with a burner, then combusted. The combustion is stopped instantaneously by terminating the pulverized RDF supply. Therefore, there is no fear of dioxin being generated through incomplete combustion as at time of system start-up and termination which extends over several hours as when operating a batch type combustion furnace.

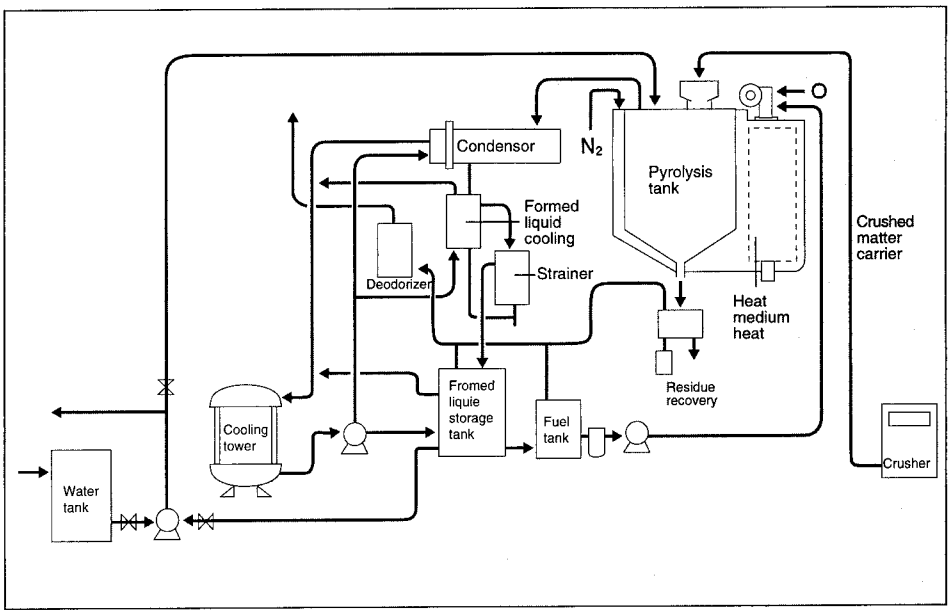
Downsizing the fuel particles increases the contact areas of these particles with air, so complete combustion is possible with a smaller volume of air, which has the effect of decreasing the volume of air jet into the combustion chamber, also enables high-temperature combustion. The dioxin existing in the exhaust gas is removed with a bag filter, while the ash containing dioxin is directly melted and decomposed inside the combustion chamber. The heat generated through fuel combustion is utilized as a heat source for generating hot waster or steam with a boiler.

Combustion at a temperature of roughly 1,000 °C decreases the density of dioxin in one cubic meter of exhaust gas to 0.44 ng, or to a hundredth part compared with a conventional type of small-scale combustion facility, and at a combustion temperature of 1,400 °C, the dioxin density is reduced to below the 0.1 ng density prescribed by the new guidelines.

The total discharge volume (exhaust gas + combustion ash and dust) of dioxin is also observed to be reduced to less than "5 micrograms/ton refuse" that is the index for total dioxin volume suppression by the new guidelines. Applying this small-scale combustion facility RDF clean combustion technology will permit small- and medium-scale autonomous entities of about a population of 100,000 to treat



Combustion fusion furnace



System flow chart

refuse by themselves. The company plans to market this new refuse treatment facility to regional autonomous entities as an epoch-making system to replace conventional types of small-scale refuse incineration systems.

A combustion facility capable of combusting 100-500 kg/hr of RDF fuel is to be marketed at a domestic price of ¥78-140 million depending on the specifications.

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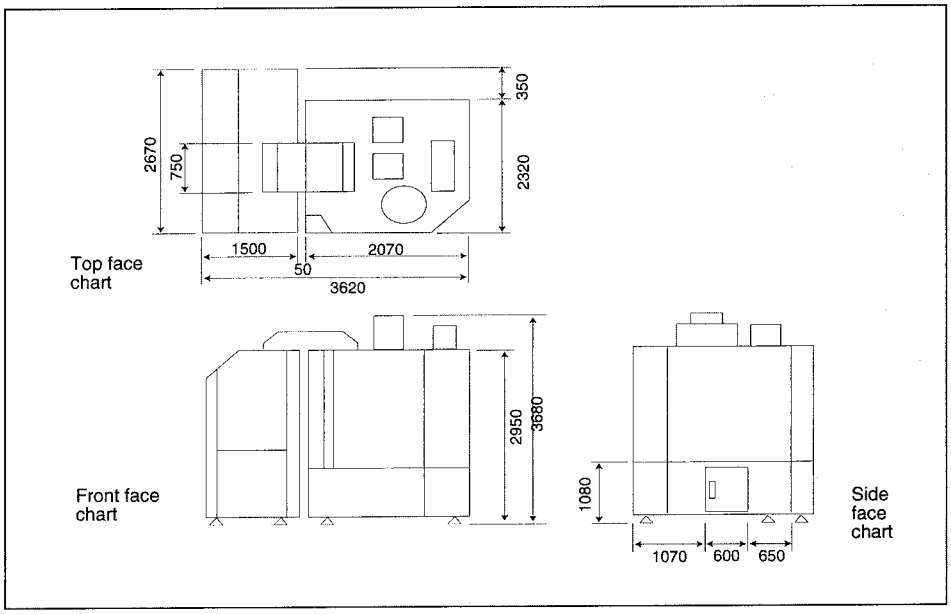

Outside dimension

97-07-008-03

System for Liquefaction of Solidified Foamed Styrol

Alps Precision Co., Ltd. has started marketing a newly developed energy conservation type solidified foamed styrol liquefaction system Model SL-50 that enables the product liquid to be utilized effectively as a fuel resource.

The system can process solidified foamed styrol which may contain labels and other foreign substances that is formed into ingots by various types of systems from different manufacturers. By using these systems, foamed styrol is compacted for mass transportation to reduce the recovery cost, which makes the system a highly efficient recycling system. The formed liquid is utilized as a heat resource, so the consumption of electric power is reduced substantially to lower the running cost, and the treatment capacity has also been increased to 500 kg/day, or five times that of conventional systems. The system is marketed at a domestic price of ¥20 million.

The treatment method uses the heat medium (molten salt) heated by using the formed liquid as the fuel, and the liquid is pyrolyzed by circulating through the jacket of a pyrolysis tank. This system enables the formed liquid subsequent to treatment to be utilized effectively, the recycling of waste foamed styrol reduces the system cost, and the power charge for the treatment about ¥3/kg. is lower than conventional one.

The ingots are set into a crusher and fragmented, then sent into the pyrolysis tank, and the prescribed volume (500 kg) is passed automatically through the pyrolysis process. The exhaust gases generated in the process of treatment have all been confirmed to clear environmental standards, so the system is operable without causing secondary environmental disruption. By installing a special-purpose burner, the formed liquid is usable as an alternative fuel in place of heavy oil, which enables conservation of both natural resources and costs. However, the main component generated is styrene monomer, so

use of the system has to be notified to the fire department.

The system crushing, pyrolysis, liquefaction and formed liquid storage processes are contained in a compact assembly to enable the system to be fabricated into a compact unit. The system has a breadth of 555 cm, depth of 285 cm, height of 370 cm, and can be installed in a space of about 34 m^2 including the working area.

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97-07-008-04

Reduction of NOx and Dioxin in Exhaust Gas of Municipal Waste Incinerator by Reburning with City Gas

Toho Gas Co., Ltd. is engaged in establish a reburning technology that will enable nitrogen oxides (NOx) and dioxin in exhaust gas of municipal waste incinerator to be reduced substantially by reburning with city gas. By using reburning technology, NOx produced from waste reacts with city gas and half becomes nitrogen (N_2). Also, dioxin can be resolved into non toxic material at higher temperature in reburning. In addition, there is the advantage that the system structure is comparatively simple.

In 1995 the reburning technology for a municipal incinerator in Aichi Pref. was examined in order to confirm the effects of reburning with city gas by Toho Gas Co,. Ltd., Tokyo Gas Co., Ltd and Takuma Co., Ltd. However, there are various types of incinerators and the condition of reburning is different for each type, so commercialization is difficult. In order to promote introducing the reburning technology to municipal waste incinerators, Tohogas Co., Ltd. is engaged in developing simulation technology which predicts exhaust gas flow, the temperature profile and the exhaust gas composition profile in the incinerator with reburning and to find the optimum condition of reburning for various type incinerators.

In the reburning technology, city gas consisting mainly of methane is firstly jetted into the incinerator at the upper part of the incineration flame (reburn zone). When the NOx produced from waste combustion passes through the reburn zone, it reacts with the methane gas, and intermediate species such as hydrogen cyanide (HCN) are produced. Part of it turns into nitrogen (N_2). Further, secondary air jetting into incinerator is added to the combustible gas after reburn zone to ultimately become exhaust gas consisting only of carbon dioxide (CO_2), steam and NOx, (burnout zone).

By using this reburning system in combination with an independent superheater and incorporating equipments in a power generation system, the energy required for the reduction of nitrogen oxides can be conserved, while steam can be provided at high temperature and pressure, to enable city gas for reburning to be recovered as energy at a high efficiency to substantially improve the entire power generation system.

The dioxin that is produced through the combustion of wastes such as polyvinyl chloride is extremely toxic. Reburning is performed at a high temperature, so there is the effect that the production of dioxin is reduced. In addition, the structure of the waste incinerator by using reburning with city gas is simpler than that with the NOx reduction method by using catalysts. The company is planning to introduce this system to regional governments which are planning to install new waste incinerators or to reform ones.

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Biotechnology & Medical Science

97-07-009-01

Enzymatic One-Step Production of the Polysaccharide Levan

Asst. Prof. H. Yanase at Tottori University and colleagues have developed an effective one-step process for producing levan, a homopolysaccharide made up of a long branched chain of fruit sugar (D-fructose) molecules. The process involves mixing a solution of cane sugar (sucrose) with an enzyme derived from Zymomonas mobilis, an alcohol yielding bacterium. Unlike the conventional approach, the process needs no fermenting microorganism, and thus eliminates a step in separating the product from the microorganism mass.

Polysaccharides are biopolymers consisting of such monosaccharide units as grape sugar (D-glucose) and fruit sugar. Because their water solution is colloidal (viscous like paste), they have a wide range of applications including thickeners of foods and the glazing agent for cosmetics. However, polysaccharides are hard to produce by a normal chemical process.

The conventional process begins by cultivating a suitable microorganism in a sugar solution. After fermentation ends, the culture solution is subjected to a second stage where polysaccharides are separated from cells and waste. However, the isolation is difficult and costly. The high production cost has so far made some applications of polysaccharides unrealistic. In the new process, a sugar solution is mixed with an enzyme instead of microorganisms. The enzyme is the exocellular fructosyl-transferase (FTase, a levansucrase) of Zymomonas mobilis, and synthesizes high-molecular-mass branched fructan (levan) from sucrose. To efficiently produce the Z. mobilis FTase, the research team took advantage of cloning technology. A gene encoding the enzyme is taken out of the bacterium, and cloned by the recombinant DNA method with another productive bacterium.

The new process is little more than mixing a sugar solution with the cloned enzyme. Left at room temperature for 1 hour or so, the mixture contains a high concentration of levan molecules. The produced levan has excellent quality. When mixed with water, it turns into an edible glazy paste with different possible applications

such as a stabilizer, a gelatinizer, and an emulsifier, as well as a thickener for foods and cosmetics.

The research team also modified the molecular structure of the FTase to facilitate the production of oligosaccharides having 4 or 5 monosaccharides. By mixing a sugar solution with the modified enzyme, oligosaccharides which are valuable as additives to health foods can be made.

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97-07-009-02

Fullerene Derivative Usable for Treating Cancer

Assoc. Prof. T. Mashino of Kyoritsu Pharmaceutical University, Prof. Emeritus M. Hirobe of the University of Tokyo and their research team have discovered that a molecular fullerene derivative shaped like a soccer ball is usable for treating cancer that has become resistant to drugs. The fullerene derivative deactivates the enzyme causing the drug resistance of cancer cells and therefore appears usable for treating cancer.

This fullerene derivative has a structure in which 2 malonic acids are bonded to the 60 carbon molecules of the fullerene structure. Experiments showed that this substance deactivates the actions of the enzyme glutathione S transferase (GST). GST is an enzyme that excretes foreign substances infiltrating into organisms, and also detoxifies and excretes some types of cancer control agents and insecticides. Using cancer control agents over long periods of time increases the effect of GST which, in turn, increases the detoxification and excretion of cancer control agents in cancer cells, so that a resistance is generated that deteriorates the effects of cancer control agents. Therefore, injecting a GST inhibitor together with the cancer control agent will eliminate cancer cell resistance to cancer control agents and enable cancer treatment more effectively.

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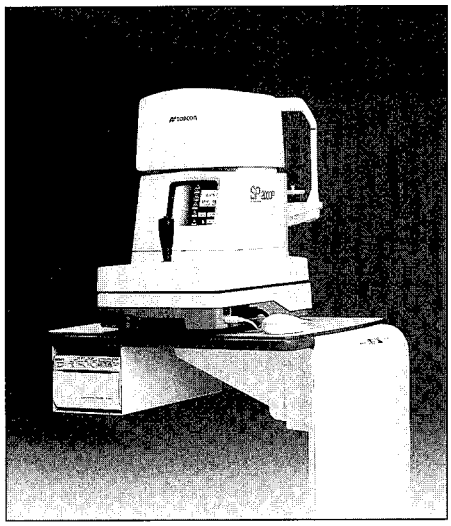
97-07-009-03

Simultaneous Non-Contact Corneal Endothelium Photography and Corneal Thickness Measurement

Topcon Corp. has developed a medical inspection system Specula Microscope SP-2000P for ophthalmologists and has marketed the system in both Japan and in 15 countries worldwide at a price of ¥3,300,000.



Specula Microscope SP-2000P

Previously, corneal thickness measurement and endothelium image photography were performed with separate equipment, but the new system enables these operations to be accomplished with a single system for the first time. The corneal thickness and endothelium images can be obtained of the center and four peripheral areas. Peripheral fixation is performed at the 12, 2, 6 and 10 o'clock positions, and different color light fixation diodes (LEDs) are used in conformance with patient preferences.

A newly developed automatic alignment mechanism (for automatic photography position matching) is introduced that enables endothelium image photography and corneal thickness measurement to be accomplished simultaneously by non-contact simply by matching the focal point to the eyes with a monitoring device. The accuracy of corneal thickness measurement is 1/100th of one millimeter.

The SP-2000P system captures the image of the endothelium cells and calculates the cornea thickness by a unique method that does not require touching the cornea. This patented procedure eliminates the risk of transmitting infectious diseases and reduces the potential physical damage to the eye. Patient comfort is increased since the examination time is shortened substantially through greater patient cooperation. Due to the non-contact operation, images can be acquired even through contact lenses, which allows the cell conditions to be observed while fitting contact lenses.

The system enables highly accurate data to be obtained for determining the indications for eye surgery, for observing the results after an operation, for identifying corneal diseases and for offering care to persons using contact lens for long periods of time. The system features an omni-directional joystick and icon-guided alignment procedures. The alignment icons are projected over the real-time image of the patient's eye, and both the image of the endothelium cells and the cornea thickness measurement are displayed instantaneously on a screen. In addition, the system incorporates software to compute and display data which serve as the criterion for diagnosis of cell density simply by clicking the central part of the photographed corneal endothelium with the accessory mouse, and can be used in linkage with a TV monitor, so features a broad scope of applications.

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97-07-009-04

Artificial Dura Mater for Brain Surgery Absorbed Naturally in the Body

Prof. Y. Ikada of the Biomedical Engineering Research Center, T. Miyamoto of the Medical Faculty, Kyoto University, and their research team have developed a new type of artificial dura mater made of a compound material that is resorbed naturally inside the body. The artificial dura is used in brain surgery. The new artificial dura is resorbed gradually after brain surgery, then regenerated into more durable dura mater. Clinical tests have confirmed that the film has no side effects, so the research team plans to commercialize the new artificial dura mater through a domestic enterprise as early as within the year for use in brain surgery.

The dura mater is a protective film lying on the inner side of the cranium and enveloping the brain, and may be contracted or damaged when brain surgery is conducted. Up till now, damage was corrected by using the patient's own tissues, similar tissues or artificial materials. However, about 20,000 brain surgery procedures are conducted annually in which artificial dura, mater is used to repair damage.

The patient's own tissues cannot always be obtained in the necessary size, and the previously used silicone sheet is reported to chronically stimulate surrounding tissues due to its non-absorbable property and to cause capsule internal hemorrhage. Up till recently, Lyodura, a human frozen and dried dura was used widely despite problems with source of supply, non-uniformity and poor sense of use. However, deaths due to the infection of Creutzfelt-Jakob disease through the medium of Lyodura have been reported, so that its manufacture was terminated in July 1996.

The research team had been engaged in research to develop an artificial dura mater usable in place of Lyodura. The artificial dura mater must feature several basic properties, such as excellent compatibility with natural biological dura mater, adequate strength for use in surgery, nonleakage of body liquid, and non-interference of dura regeneration and gradual absorption into regenerated dura mater.

The newly developed artificial dura mater is made of the same material used for producing surgical sutures and which is resorbed naturally inside the body. It has a structure in which a polyglycolide nonwoven cloth is sandwiched between a pair of lactic acid-caprolactone copolymer thin films. It is thinner and can be stretched more easily than conventional types of artificial duras, and is highly resistant to tearing. Further, animal tests have confirmed that there is no rejection symptom. In the body, the artificial dura mater undergoes hydrolysis and the decomposition substances are ultimately discharged outside the body, so it is safe for use in the body. The new artificial dura mater was used in 18 cases of brain surgery at Kyoto University's Affiliate Hospital and the patients are recovering smoothly without any side effects.

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97-07-009-05 Another Biocompatible Polymer

Prof. Y. Nagasaki and K. Kataoka at the Science University of Tokyo, Prof. Y. Sakurai and T. Okano at Tokyo Women's Medical College, and colleagues have developed a biocompatible polymer causing little thrombosis on its surface. The new material proved as antithrombogenic as a typical conventional biocompatible polymers.

There are strong needs for antithrombogenic materials in the field of medicine. Catheters and hematological pipettes must have a surface coated with an antithrombogenic material to work well. A heart-lung machine and other artificial organs having extracorporeal circulation must be designed to ensure little or no thrombosis on the part in contact with blood.

The new material is a block copolymer of /2-hydroxyethyl methacrylate/ (HEMA) and /bis (trimethylsilyl) methylstyrene/ (BSMS). A block copolymer is a copolymer that can be divided into blocks of repeating monomers in such a pattern as AAAAABBBAAAAABBB, where A and B are different monomers. With an average molecular mass of about 15,000, the block copolymer is made up of HEMA and BSMS monomers at a molar ratio of nine to one. Poly(HEMA), the homopolymer of HEMA, is hydrophilic, and is favorable because the polymer hydrophilicity has been found to be key to keep blood protein and platelets (thrombocytes) from sticking to the polymer. Interestingly enough, poly(BSMS), the homopolymer of BSMS, is strongly hydrophobic, and is unqualified as a biocompatible material.

Samples of poly(BSMS-block-HEMA) with different molar ratios of the two unit monomers were tested, and showed that, at 10 mole% of BSMS, the block copolymer exhibits the greatest water-content capacity and wettability (more than the HEMA homopolymer), and thus hinders the activation of blood platelets. The copolymer prevents blood platelets from forming a blood clot as effectively as the HEMA-styrene-HEMA triblock copolymer, a common antithrombogenic material. The new material is rubberlike at room temperature, and once applied over the surface of a catheter, is long-lasting.

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97-07-009-06 Electronic Endoscope System

Prof. K. Katsu at Osaka Medical College has developed a computer system for processing endoscopic images of the gastrointestinal mucosae to determine whether or not a cancer is present. The system can diagnose early carcinoma. In combination with the Internet or the like, the system will provide diagnosis support to compensate for absence of experienced specialists.

The system is made up of an endoscopic television camera, an analog/digital signal converter, an image processing and analyzing unit, a monitor (color cathode ray tube), and a printer. The system determines the dominant wavelength in each mucosal image illuminated by the standard light source of the machine. It also calculates values that would be dominant wavelengths if the mucosal tissue were under the four CIE (Commission Internationale de l'Eclairage) standard illuminants. Tests with 16 patients including early gastrointestinal carcinoma, demonstrated that the system can definitely distinguish carcinomas from normal tissue and ulcerous lesions, so that gastrointestinal cancers can be reliably diagnosed.

Data were collected about each type of gastrointestinal cancer, and the cancer diagnosis expert system for endoscopic images was programmed. The system could be combined with the Internet or other information system to build up a scheme enabling a physician to make the correct diagnosis of cancer by accessing a central knowledge database. Development of an intelligent endoscope system diagnosing cancers in the stomach, duodenum and large intestine with little burden to the patient is also planned.

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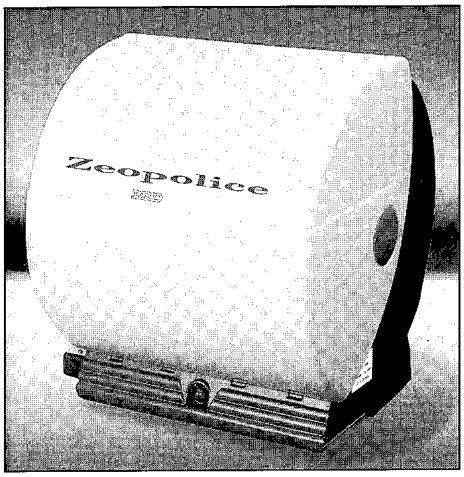
F L A S H

Security Alarm System for Outdoor Use

MASHIRO Co., Ltd. has started marketing an outdoor security alarm system Zeopolice at a domestic price of ¥400,000, excluding the installation cost.

Zeopolice sounds a siren by remote control whenever some incident occurs outdoors such as in a booth for exchanging pachinko balls into prizes. Switching the device on by remote control opens the cover and actuates a built-in lamp and sounds a siren alarm. Crimes such as convenience store holdups have increased lately, and Zeopolice was developed to cope with this situation. The alarm is installed on the roof or some other elevated spot, and operation by remote control scares off the culprits and sounds an alarm signal to inform nearby people. The system can also be actuated from a hidden spot without the culprits being aware.

The remote control system can be operated from a spot about 50 m away. The alarm system weighs 18 kg and is marketed by Tokyo Trading Co., Ltd.



Zeopolice

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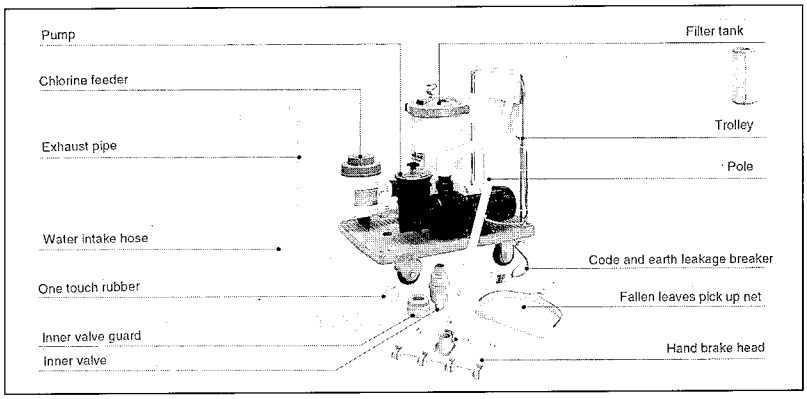
Compact Swimming Pool Cleaner System

AOYI Company Ltd. has developed recently a swimming pool cleaner system "Aqua Kids H9 200" for small swimming pools and has started selling for use by kindergarten and nursery schools throughout the country. The domestic selling price is ¥530,000 per set.

This pool cleaner system was developed jointly through the cooperation of WATERCO Ltd. in Sydney Australia. The Flow Rate is 250 l./min. of water through the pump and then passed to the filtation system with a cartridge inside to remove rubbish, filth, hair and other foreign substances. Water can be cleaned very easily without having to replace the entire or a part of water in the pools.

For cleaning, since each system is mounted on the trolley, even a female instructor can carry it to the pool-side without any problem, and then to connect a suction house to the cleaning, head insert the other end to the pump, and finish to the water discharge pipe of the WATERKING Chlorinator fitted at the end of the system. The plug is to be connected to power source and switched on and for operation the telescopic handle must be grasped firmly by hand to start cleaning. The water is circulated, filtered, cleaned and dis-contaminated. The water decontamination is performed by the Waterking Chlorinator with chlorine to be fed during operation.



Aqua Kids H9 200

Conventional types of swimming pool cleaners have been so far designed to work with pools which are longer than 25 m, but since many of such kindergarten & nursery facilities are equipping with swimming pools of small size for their children, the compact system with down-sized pump & filtration tank is required to be developed for use at small swimming pools of about 7m. long and at the reasonable prices.

Since 12 t. of water ($12m^3$) can be sucked up per hour, the pool water (the pool measuring $3m \times 5\ m \times 0.5\ m$) must be circulated and filtered at a time in about 40min. If the water would be circulated and filtered for three times a day. the pool water can be maintained in clean and crystal state. The power cost only ¥18/hr, and the pool can be maintained in good condition economically by reducing the number of complete water changes and without lowering the water temperature. The filtration system with a water contact area of 5 m^2 and filtration capacity of 20~5 μm completely removes not only sand and hair but also slipperiness at pool bottom as well as the minute dirt particles and other foreign substances floating in the water. In addition, a chlorination system is used that prevents children from bacteria such as coliform O-157, so this system will help to maintain the swimming pools in sanitary and safe condition.

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JETRO

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